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## HIGH TENSION AGAIN.

IT seems pretty evident that the outcry against high tension currents in America is more due to politics and jobbery than anything else. It is certainly a very dreadful thing to contemplate the number of deaths which have so recently occurred in that country through the victims coming into contact with the wires conveying the lighting currents; but, after all, the peculiar methods adopted by our enterprising and, in too many cases, reckless Transatlantic cousins, have been mainly responsible for the casualties which have set the whole of New York by the ears. Higher voltages than that which is generally employed in the States have been tried in this country, and so far, we are thankful to say, without any fatal consequences; and it is not too much to assert that even if high tension currents become extensively employed in England, we are hardly likely to suffer the evil consequences that have hitherto been the fortune either of the American light companies' men or the general public, for assuredly the safeguards against danger are more carefully worked out on this side by both legislative and individual effort.

We have so often set up American enterprise of the right sort as an example to be followed here, that the dead lock now existing is exceedingly unfortunate, for matters pertaining to electrical development over there just now appear to be on the verge of a crisis, and the sale of the commonest appliances is threatened by fearsome ideas abont electrical dangers. These fears are not likely to be set at rest when Mr. Edison asserts that the wires should go underground, that even then underground circuits cannot be operated with success and safety, and that his personal desire is to prohibit entirely the use of alternating currents, which, he says, are as unnecessary as they are dangerous. Mr. George Westinghouse naturally states his belief that overhead wires, properly insulated and maintained, may be considered perfectly safe, although he is in favour of having them underground. He is perfectly within his rights in protesting against the general prohibition of high tension currents because they are dangerous to life, for if this prohibitive policy were carried out in all things, we should be deprived of railways and many other advantages which are absolutely essential to business.

The National Electric Light Association Executive Committee has seriously considered the question, and after discussion several resolutions were adopted. The committee is of opinion that currents, both direct and alternating, of the pressure now in use in America are absolutely necessary for the successful and economical distribution of electricity for lighting and power purposes, and that to reduce the electromotive force to any degree would greatly cripple the electric light and power industries in which so much money has been invested, and which have become a public necessity. The cause of the fatalities from contact with the wires is assigned to faulty construction and defective insulation, coupled with restrictive legislation and divided responsibility which have prevented the repairs and reconstruction which would have ensured perfect safety. Furthermore, the committee believes that such are the improvements which have been made in insulation, that overhead wires may now be rendered quite free from danger.

It may be taken that all this will result in the public companies and authorities seeing the necessity of adopting proper rules and regulations for ensuring the use of well insulated conductors, the systematic construction and repair of the lines, and the necessary precautions to protect the public and those, who, engaged in the duties of electric lighting, may involuntarily be placed in positions of risk.

Luckily, in this country, considerable headway has been made in the direction of guaranteeing safety, but more remains to be done, and the deplorable condition of New York must impress upon us the necessity of leaving no stone unturned to keep free from anything which shall bar progress. Americans rapidly reassert themselves, and work will go on more energeti-

cally than ever, but we are so little advanced in the practical applications of electricity, that anything in the shape of the accidents which have fallen to the lot of New Yorkers would have a far more damaging effect upon us, and it would be very long before we should emerge from the position in which such a mishap would place us. The latest authentic information, however, shows that the scare in New York is gradually subsiding, and the effects of the darkness in many districts which were lately so brilliantly lighted is beginning to make itself seriously felt.

WE noticed on Saturday last in the *Weekly Dispatch* a rather curious circumstance. In the report of the action against Messrs. Claude Marks and Charles Woolf, editors and proprietors of the *Mining Record*, and Mr. Marix, an advertising agent, on the charge of extortion, there occurs the following passage in the examination of Mr. Bebro :—Marks said "you had better arrange with Karl von Buch and let him have 500 shares, which he has sold as a bear, as he is a most dangerous man, and has great influence with my brother ?" "I told him that he (Karl von Buch) could do what he liked ?" Now we have only come across this name but once, and that was in connection with the exploitation of the Electric Traction Syndicate's Northfleet tramcar system. Can there be more than one Karl von Buch ? This is worth ascertaining.

DIFFERENT people look at things from a different point of view. Those of our countrymen who unpatriotically deprecate everything English in comparison with what is done in America, might profitably read a paper recently read by Mr. T. D. Lockwood before the American Institute of Electrical Engineers, on his experiences of matters electrical in this country. The results are mostly decidedly flattering. Of telegraphy Mr. Lockwood says :—"I found no place too small for a telegraph office ; moreover, in my opinion, telegraphy is cheap in spite of the fact that the address and signature have to be paid for —" ; we certainly have often had it dinned into our ears that in America "no town is considered too small or too unimportant to be without its telegraph," this being said in unfavourable comparison with the telegraph facilities in this country.

INSTEAD of condemning or advocating wholesale State telegraphs, Mr. Lockwood considers that under a monarchical government, where the latter is permanent and usually stable, such a system works favourably, but in cases where republicanism finds favour a better service is provided by keeping telegraphy in the hands of private companies, in fact in the latter case Mr. Lockwood thinks State telegraphy would be an unqualified evil.

AS regards the electric light, Mr. Lockwood points out that although the progress made in this country cannot be considered as great, yet there is actually more being done than appears to a casual observer ; this is particularly the case in the Metropolis where the magnitude of the work done is lost in the vastness of the wilderness of buildings comprising the metropolitan area. Though the two points of telegraphy and the electric light form only parts of Mr. Lockwood's interesting discourse and there is much said about both of them ; the general idea that one gathers from the lecturer's impressions, after allowing for the natural self-satisfaction that flattery confers, is that the old country is well in the van of electrical progress and has no reason to be ashamed of the position she occupies.

THE short paper on the "Blavier Method," which we publish on another page, does not contain anything actually new in the arrangement, but the author thinks that it might nevertheless prove of interest to many of our readers.

A GENTLEMAN well known in the electrical world, who has just come back from the Antipodes, thinks that there is much business to be done in Australia, but he fears that the orders will, in the main, go into American hands. He complains greatly of the lack of smartness and the generally apathetic behaviour of Englishmen who, with better electrical machinery than can be obtained in any other quarter of the globe, stand passively by and allow others to reap the harvest which the mother country should justly claim as her due.

THE Thomson-Houston Electric Railway system is very effectively set forth in a beautifully arranged pamphlet issued by the company's London representatives. There are three methods of supporting the main conductor, which is overhead, and we really hope that Mr. W. S. Graff-Baker, who has come over to England to "Show us how it's done," will be successful in arranging for the electrical working of tram lines which shall satisfy both technical and commercial demands.

REFERRING to the communication from our correspondent on the Zipernowsky Electric Tramway, we cannot agree with the claimed superiority of the design. In the first place, the conduit, owing to the side thrust, will have to be of a specially strong construction, involving an expense which the originator can hardly have considered. Sometimes it will happen that more passengers will sit on one side of the car than the other ; this unequally distributed weight, together with the lateral swinging motion which necessarily takes place, must involve a structure of the most substantial kind in order to give a margin of safety. Supposing there is an obstacle on the rails, causing the wheels to mount, and even leave the rails, will the car not tumble on its side, or, at least, jam itself tight without immediate hope of extrication ? It is claimed that cars on this system can be made narrower, but this can be done with ordinary cars, and we find the narrow gauge tramways obtaining favour in many cities. We doubt whether any tramway engineer, to say nothing of timid Local Boards or the public, will look with favour upon such a scheme as that devised by M. Zipernowsky. Some of the so-called advantages mentioned would not, in this country, be of any account. For instance, with regard to the reference to the pavement for wide tracks, the tramway proprietors here are bound to pave more of the road than is contained within the track.

THE Committee of the proposed Edinburgh Exhibition now looks suspiciously Edisonian, and readers will not fail to see the result of the action of Major Flood Page which was reported in the REVIEW of the 1st inst. We hope, however, in the former respect we may be mistaken.

## THE ZIPERNOWSKY ELECTRIC TRAMWAY WITH A VERTICAL RAIL.

[FROM A CORRESPONDENT.]

THE constantly increasing intercourse in the larger towns naturally makes the want of suitable means of transit easily available to the public to be more distinctly felt. The most suitable means for meeting this demand are at present indisputably the tramways, since they render it possible to effect transit of the masses most conveniently and most suitably. Certain hindrances, however, have hitherto stood in the way of their universal introduction and development, as we will now proceed to show.

The normal rail, almost universally employed for tramway purposes, makes their introduction often a difficult task, and, in many cases, prevents them from adapting themselves to existing requirements. Further, the laying of a line with normal rails on the level of the existing streets is not only a relatively expensive work, but it involves taking up and relaying the pavement for the average width of three metres along the whole length of the line, and increases the cost of working as it necessitates the repairs of the pavement for so wide a track.

As a further defect of the tram lines with a normal horizontal track we must note on the one hand the want of elasticity in the movement, and, on the other, the relatively too great demand for space, which renders it impossible to carry such tramways along lines of road into which it is necessary to use curves of a small radius or which are too narrow to admit of communication with tramcars of ordinary dimensions over and above the usual traffic. In consequence of these defects the tram lines are compelled to leave many important channels of traffic untouched and to traverse only the wider streets.

To meet some of these defects narrower tramways have been proposed, which, however, introduce new difficulties. Thus the stability of the narrower cars is reduced, which makes itself unpleasantly felt where there is a depression on one side of the track, a state of things which frequently occurs.

These disadvantages seem to be almost entirely obviated or reduced to a minimum by the system of tramways with vertical rails. The principle of the line is that the wheels upon which the weight of the car rests run on a double slit-rail, beneath which there is a channel of masonry; into this channel there extend strong arms in fixed connection with the car and resting by means of guide-rollers upon rails laid down on both sides of the channel, and thus giving the car the necessary stability.

The execution of this principle is shown in the figures 1, 2, and 3. The body of the car, K, with its framework, R, rests by means of the cross-bearer, T, upon the running wheels, L, L′, which are fixed obliquely, converging downwards in order to transfer the horizontal pressure (arising from unsymmetrical loading, and from oscillations of the car) to the double rail, S, S (running rail).

From the frame of the car the strong arms, A, extend through the slit, Z, down in to the channel, N. These arms, which are firmly fixed to the frame, support at their lower end guide wheels, or rollers, F, which rest against the side rails, E, E′, and thus keep the car upright. If, *e.g.*, the load on the right side of the car is greater the wheels on the left side will press against the left rail, and conversely.

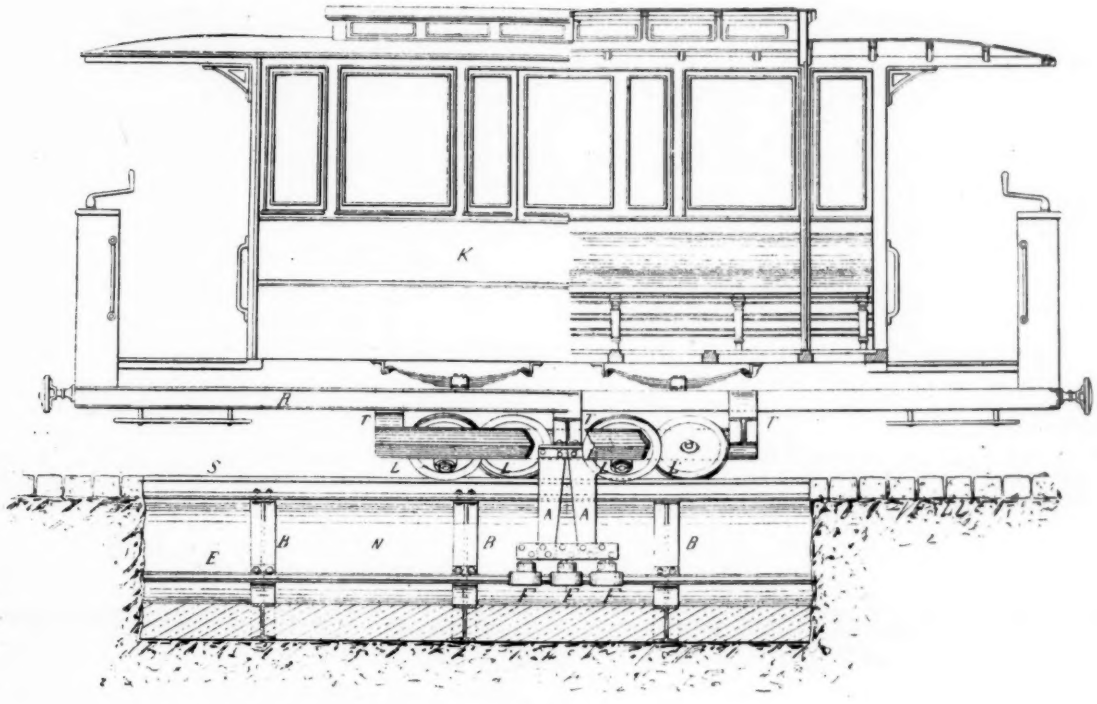


FIG. 1.

Both the main rails, S, S, and the guide rails, E, E′, rest on sleepers, B, which are laid in the earth at suitable intervals. Between these sleepers the channel is made in a suitable manner, for instance, of bricks, coated with cement.

The line thus described differs therefore in its outward construction very decidedly from the common lines with horizontal rails, since in the former there is only one line of rails on the level of the street, whilst the second rail lies beneath in the channel above described. The plane connecting these two rails is vertical, whence this system is called a tram line with a perpendicular track.

According as the line is arranged for working by means of cables, chains, or electric power, the channel serves to receive the cable, &c., or the electric leads. At suitable intervals there are placed refuse collectors which open into the sewer. The cars, without any alteration in their make or in the arrangement of the line, can be propelled at will by horse-power or by other motors.

That in the present stage of industry electricity is the most suitable agent for street traffic cannot be questioned. The electric car moves silently at a speed not attainable by animal power through the busiest quarters of the city, and the control which can be attained in electric vehicles makes this system surpass all others in

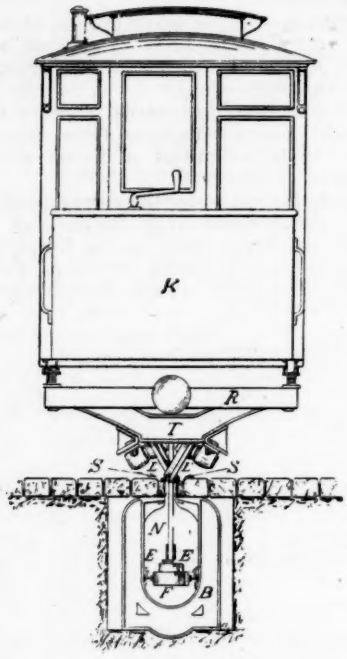


FIG. 2.

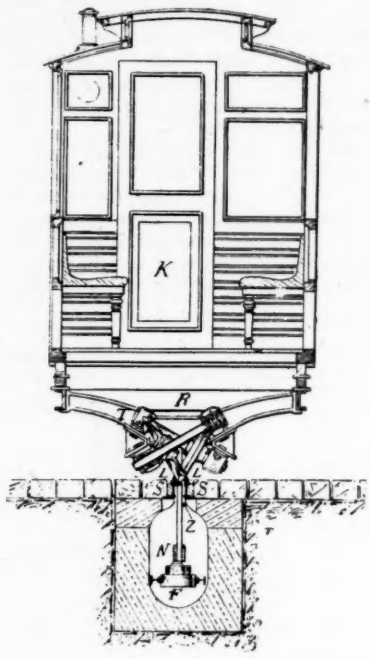


FIG. 3.

safety. Hence we believe that electric tramways will rapidly become adopted and will, in time, supersede all other systems.

If vehicles are to be impelled by electro-motors the channel as above described forms a very suitable space for placing the electric leads, the slit of the upper rail being utilised to introduce the contact arrangement into the channel.

The regulation of the speed of travelling is effected by inserting variable resistances; stoppages are produced either by means of a friction brake, or by short-circuiting the armature of the motor by a suitable resistance or by reversing the field magnet current of the electro-motor, in consequence of which it seeks to revolve in the opposite direction, and thus stops the car in a relatively short time.

The construction of the points is of great importance in tramways in general, but especially in such as are driven by other than animal power—steam, electricity, &c. Though in such lines automatic points would be essential, we find them exclusively worked by hand and attended to either by a pointsman or by the conductor. The cause lies in the difficulty, not to say the impossibility, which depends on the present construction of the line. It lies entirely in the level of the pavement, which evidently cannot be interrupted by any mechanism which, further, would be rapidly rendered useless by mud and dust.

In the line here described, the execution of automatic points is attended with much less difficulty, as all the movable parts are in a protected position beneath the level of the street.

The principle of these points is characterised by the simultaneous application of an upper tongue for the

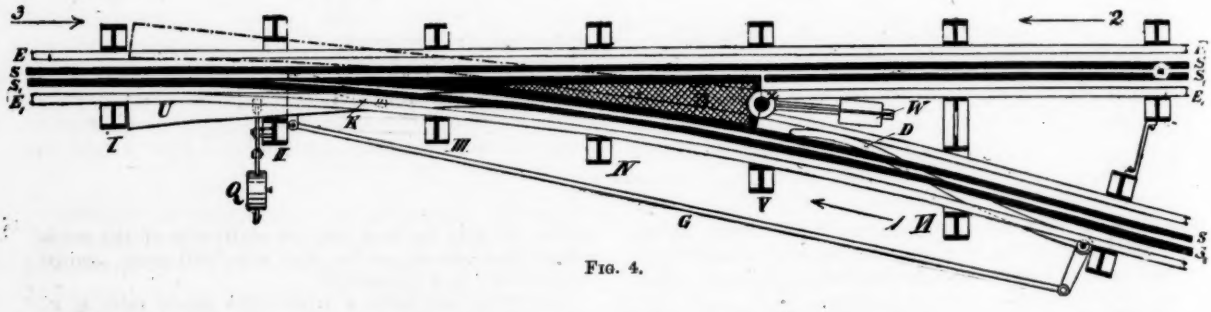


FIG. 4.

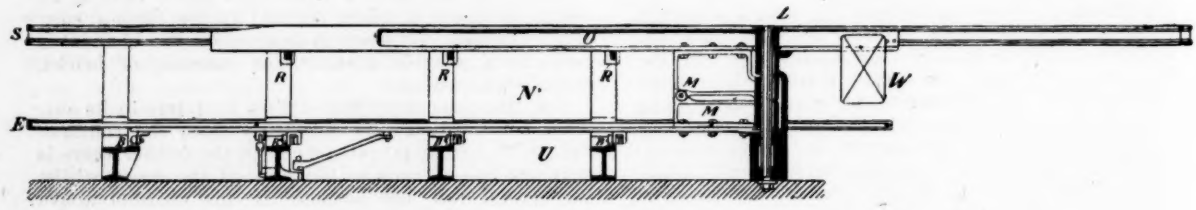


FIG. 5.

running rail and a lower tongue for the guide rails. The upper tongue, on account of the pressure of the cars or the incidental pressure of cars crossing the points diagonally, rests upon bolts which are thrust forward automatically when the points are turned. The lower tongue is carried on rollers or gliding surfaces.

A special way of carrying out this principle with self-acting displacement is shown in figs. 4 to 9. Fig. 4 is the ground plan, fig. 5 a longitudinal section, and figs. 6, 7, 8 and 9 transverse sections in different parts.

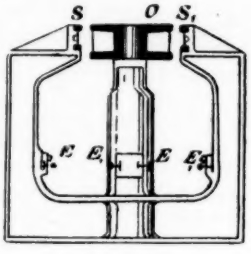


FIG. 6.

The upper tongue, O, is pointed ; the lower tongue, U, is flat. Both turn on one pivot, Z, which is inserted in the sleeper, V. The two tongues are connected by a contrivance which allows a certain play room between them, since the lower tongue has to traverse a greater distance than the upper.

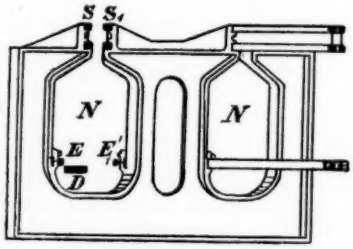


FIG. 7.

Whilst the tongue, O, applies itself laterally to the running rails, S, S, the flat tongue, U, pushes itself under the guide rails, E, E. In most cases the proportion between the radius of the curve and the distance of the guide rails from each other is such that the lower tongue, U, could not be made pointed, or, at least, they would be much too thin at the point. The rollers, F, are broad enough to be supported by the lower tongue.

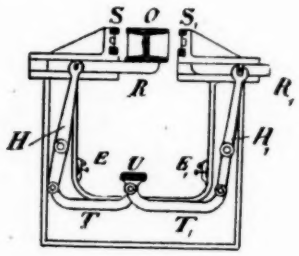


FIG. 8.

Fig. 2 shows the tongue, U, as running on the rollers, B ; the pointed tongue, O, lies on the bolts, R, $R_1$, which are pushed from the right and the left under the tongue, O, by the rods, T, $T_1$, and the levers, H, $H_1$ (Fig. 8), according to the movement of the tongue.

In the construction shown in the figures, the points are set automatically by the guide rollers, F, or any other part of the car projecting into the channel, N. This is effected by means of the setting lever, D, the traction rod, G, and the lever, K, which push both tongues to the right into the position shown by dots, when the car leaves the points in the direction of the arrow, 1.

When the car has passed the points, the weight, Q (fig. 9), or a suitable spring pushes both tongues to the left into its original position, so that a car coming from 2 or 3 can proceed straight on.

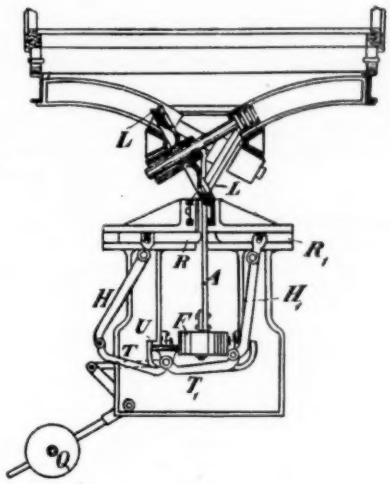


FIG. 9.

A peculiar advantage of this construction of points is that they can be set gradually and without any shock. This is effected both by the form and the length of the lever, D, and by the circumstance that the acting point of the force can traverse a distance almost equal to the entire width of the channel.

We will now sum up the chief advantages of this construction of the cars and of the line, which are as follows :—

1. The car does not run upon two rails separated from each other by the normal breath of the tramway but upon a single twofold line, whence the surface of the road is interfered with to a slight extent only.

2. Hence the pavement is spared to a great degree, since in repairing the line or in altering its position the road has not to be taken up for more than a metre in width.

3. If electric motors are used a better and safer insulation than has hitherto been practicable is ensured in consequence of the greater depth of the channel.

4. As the upper bearing rails with the lower guide rails and sleepers form a pipe-like conduction for the whole length of the track, the upper part of the structure attains a degree of stability and elasticity with which no other existing construction can compete.

5. No subsidence of the line on either side is possible, and hence one of the chief causes of unsteady driving is removed.

6. As the stability of this construction does not depend on the breadth of the car, it becomes possible to use narrower cars, and hence this kind of tramway may be used in the narrowest streets without hindrance to the ordinary traffic.

7. The simple application of self-acting points.

From the above descriptions and figures it is easily seen that an electric tramway constructed on this principle possesses all the attributes needful for creating a means of traffic adequate to the requirements of large towns in a degree not attained by any previous system, and calculated to a great degree to displace the omnibus traffic.

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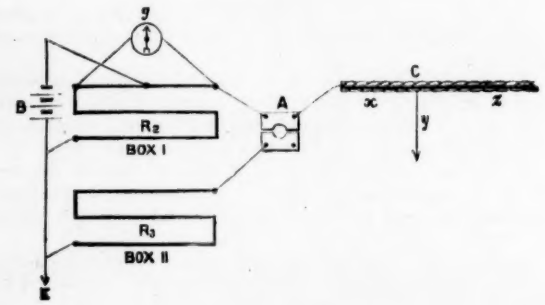
**The New Electric Light Works at Wolverhampton.**—The erection of the new works of the Electric Construction Corporation, Limited, has commenced. They will be of a most extensive character, and complete in every detail.

## THE BLAVIER METHOD FOR LOCALISING FAULTS IN SUBMARINE CABLES.

IT is well-known that the Blavier method of testing suffers from the disadvantage of exposing the fault to a higher potential when the distant end of the cable is insulated than when it is earthed. The consequence is that the current through the fault to earth is of different strength in the two cases, and that the resistance of the fault which is a function of the current must vary between the two measurements. This difficulty can partly be overcome by using a smaller electromotive force when the cable is freed than when it is put to earth, and the ratio between the two battery powers can be found approximately by calculation. But there are other sources of disturbance produced by the earthing of the cable, such as the shunt circuit formed by the length beyond the fault, and as these errors cannot be compensated for, it is only in some few cases that a localisation by Blavier's formula can be relied upon. Refuge is then, as a rule, taken to the so-called "overlap methods" of testing from *both ends* of the cable, viz., localisation by the two measurements with the distant ends insulated, or by the two measurements with the distant ends earthed. Both these, but especially the latter, have been developed into tests of great practical merit and accuracy by Messrs. A. E. Kennelly and J. Anderson.

There are, however, cases when, if possible, it is desirable to localise a fault by *measurements from one end only*, and to be enabled to do this with as much accuracy as possible, it occurred to Mr. Jordan, one of the acting electricians of the Great Northern Telegraph Company in the Far East, that the following modification of the ordinary Blavier method might be made, in order to remove some of its disadvantages as mentioned above.




The diagram shows Mr. Jordan's arrangement. Box I. is an ordinary Wheatstone bridge with resistance coils, and Box II. an ordinary resistance box from 1 to 10,000 ohms. G is a Thomson's reflecting galvanometer, A is a commutator, and to the same and the bridge is connected a cable, in which there is a fault, $y$, with the lengths, $x$ and $z$, on either side thereof.

The *modus operandi* is as follows :—First, the resistance is measured in the usual manner with the other end of the cable earthed and with no plug in A, and balance is obtained by unplugging a resistance, $R_2$, in Box I.; then $R_2 = x + \frac{yz}{y+z}$.

The moment it is observed that the cable is freed at the other end, a plug is inserted in A, $R_2$ *is left unaltered*, and the resistance in Box II. is adjusted until the spot of light again covers zero; then $\frac{R_3(x+y)}{R_3+x+y} = R_2$, from which $x + y = \frac{R_3 R_2}{R_3 - R_2}$.

We know that $x + z = R$, and thus we have the equations requisite, and arrive at the following expression :—

$$x = R_2\left(1 - \sqrt{\frac{R - R_2}{R_3 - R_2}}\right).$$

From this it is manifest that when the cable is insulated the current is shunted by the resistance, $R_3$, in the same way as $z$ is a shunt when the cable is earthed, and the result is that the fault in the two cases is acted upon by currents of more equal strength than in the ordinary Blavier test; and further, that it is possible to take the tests so quickly and nearly instantaneously after each other, by having adjusted the resistances, $R_2$ and $R_3$, in accordance with the two conditions, that the resistance of the fault may be assumed to remain approximately constant during both measurements.

It should be mentioned that Mr. Jordan was well acquainted with Mr. H. Kingsford's method (*Journal of the Society of Telegraph-Engineers*, December 10th, 1885), when he devised the above arrangement, and I may add that Mr. Jordan has tried his test practically on several occasions, and invariably proved it to be superior and to give better results than the old method.

P. CHR. DRESING.

Copehagen, *November 8th*, 1889.

## SIR WILLIAM THOMSON'S CHAIN OF ELECTROSTATIC VOLTMETERS.

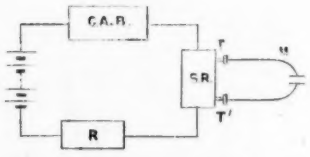
By ANDREW W. MEIKLE, M.A.

*(Continued from page 526.)*

The sensibility required for the different ranges of the multicellular voltmeter is obtained by varying the number of cells and vanes, the cross section of the suspending wire, and also the length of wire used. At first a little difficulty was experienced in obtaining constancy in the wire suspension, and a little trouble was consequently given by having to reset the zero from time to time. This difficulty was caused most probably by the straining of the wire in the process of drawing, so that some little time elapsed before it came to a normal condition. A very carefully drawn iridio-platinum wire is now used, and is subjected to a preliminary tempering by heating, longitudinal tension, and torsion. The results with this suspension have been most satisfactory, and our standard instruments which are constantly in use now give no trouble from changes of zero.

*Standardising of the Multicellular Voltmeters.*

For low potentials the instruments are graduated by joining their terminals to those of a standard anti-inductive resistance through which a current measured by one of Sir William Thomson's standard Centi-ampere Balances is passed. The arrangement is shown diagramatically in fig. 4. A rheostat of platinoid wire is joined up in the circuit in order to vary the current to any desired value. The standard resistance



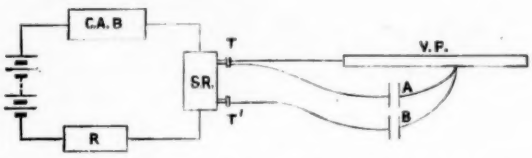

C, A, B, Centi-ampere Balance; R, rheostat; S, R, standard resistance; M, multicellular

FIG. 4.

used is wound with platinoid wire, and its temperature variation is very nearly $\frac{1}{10}$th per cent. per degree Centigrade so that any uncertainty in the estimation of the temperature may be neglected. The Centi-ampere Balance is the standard used in the Physical Laboratory of Glasgow University, and its accuracy is certainly within $\frac{1}{15}$th per cent. These particulars are given simply to show that uncertainties in the standardising apparatus have been as far as possible removed. The multicellular is joined up to the terminals, T, T', of the standard resistance, and shows the difference of potential

between them, which at any one time is equal to C × R, where C = current in ampères through the resistance as shown on the balance, and R = value in ohms of the standard resistance.

The number of ohms in the standard resistance is varied from time to time, so that the deflection on the balance may be sufficiently large to enable any possible error in the reading of tbe position of the weight to be so extremely small as to be neglected. By this method and using the battery power at our disposal, it is possible to push the graduation of the instruments up to 140 volts with great accuracy.

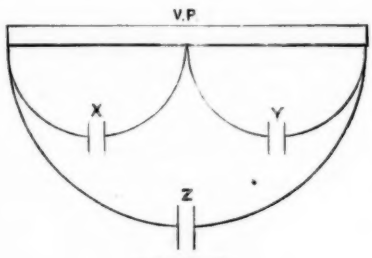



C, A, B, Centi-ampere Balance; R, rheostat; V, P, volta pile; S, R, standard resistance.

FIG. 5.

For ranges above this point a Volta pile is used to augment the potential, as shown in fig. 5. This pile consists of zinc-copper couples fixed to a vulcanite frame in such a manner that when their extremities are dipped in water the liquid is drawn up by capillary action and a chain of little cells is formed, each of which gives about 0·9 volt. These Volta piles are made up in sets of 200 couples, and the stand containing each set measures about 50 by 10 centimetres. We have found them give excellent results, and can, by those we have, obtain over 1,000 volts.

The zinc end of the pile is joined to the positive terminal, T, of the standard resistance, and a voltmeter, A, formerly graduated by the method explained above, is joined up to the same terminal and to a point in the pile such that it gives a convenient reading on a sensitive part of its scale—say, for example, 100 volts. Another voltmeter, B, also graduated to 140 volts, and whose graduation it is wished to extend, is then joined to the other terminal, T′, of the standard resistance and the same point of the pile as A. The Multicellular, B, then measures the difference of potential between the terminals of the standard resistance, *plus* the difference of potential due to the portion of the pile measured by the Multicellular, A. By this means the graduation of Multicellular, B, may be pushed up to 240 volts. By substituting Multicellular B for A, and using it to measure a higher number of volts, a third instrument can be graduated up to 380 volts, and so on. By this




V. P, volta pile.

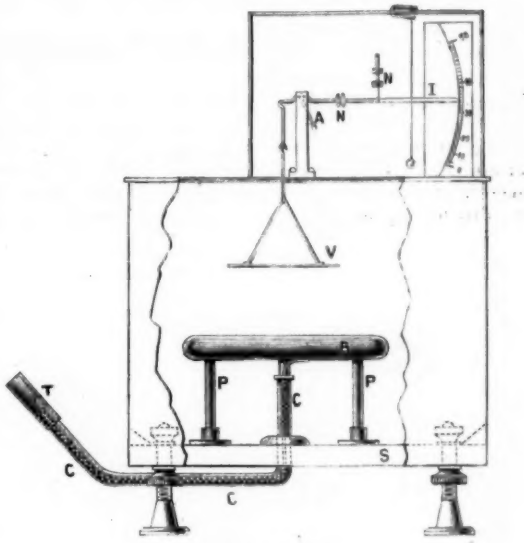
FIG. 6.

means a chain of standards has been obtained giving readings on sensitive portions of their scales throughout the entire range, so that instruments can now be graduated by direct comparison, but two of a lower grade, X and Y, joined in series, as shown in fig. 6, are always used in the graduation of a higher range instrument, so that their indications may be amply sensitive as compared with the one being standardised. These standards, of course, undergo periodical checkings, and are constantly being compared one with another to make certain that they have not been injured in any way since their calibration.

These voltmeters have now been in use in the Physical Laboratory of Glasgow University for some time, and have proved a great convenience as, for many purposes, they save a large expenditure of time which would be taken up in making temperature corrections, calculations, &c., were other voltmeters used. We have been able, by using them, to determine by direct experiment, how far other voltmeters could be relied upon to give accurate measurements on alternating circuit under varying conditions as to period of alternation, temperature, &c. The instruments in conjunction with the Volta pile have also proved very useful in standardising the electrometers used in the investigation of atmospheric electricity by Messrs. Maclean and Goto, on which a preliminary Note was communicated by Sir William Thomson to the British Association.

### *The Electrostatic Balance.*

The arrangement of the parts of this instrument is shown in figs. 7 and 8. The fixed portion of the condenser in this instrument is a brass disc, B, which is supported from a slate base, S, on three glass pillars, P.

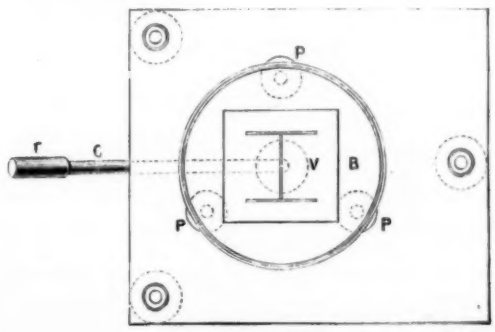



Electrostatic balance.

FIG. 7.

The disc is provided with the well-known Thomson "hole, slot and plane" arrangement, so that it always rests in exactly the same position on its supports.

A wire thickly covered with India-rubber passes from a terminal, T, through a glass tube, C, C, C, and makes connection with the disc by a spring contact;




Electrostatic balance.

FIG. 8.

the glass tube being filled with paraffin to prevent the lodgement of moisture and give great resistance to disruptive discharge. A sheath formed by a short piece of glass tube pulls up over the terminal, T, and protects it from being touched by accident. The slate base plate

is provided with three screw levelling feet. A brass case fits upon the slate base plate, and fixed to its top is a metal scale box with a glass front which contains the indicator and scale. The movable part, V, is a square aluminium plate, supported by two long links, which pass through a slit in the top plate of the case to two knife-edge stirrups on one end of the counterpoised indicator, I. The whole movable portion is supported by knife-edges on two brass pillars and has a short arm, A, with a knife-edge stirrup at its extremity attached to its axis. The weights which fix the constant of the instrument hang on this stirrup.

The instrument is usually graduated by direct comparison with a Standard Vertical Scale Voltmeter, and has a scale with divisions corresponding to equal differences of potential. The scale is graduated from 0 to 50, and three weights are provided such that, with the first alone hung on, the constant is 250 volts per division, with the first and second weights on, it is 500 volts per division, and with all three weights on, 1,000 volts per division.

*(To be continued.)*

## THE CARDEW RECORDING VOLTMETER.

THE voltmeter which we illustrate below has been recently brought out by Captain Cardew, and is intended to record variations in the potential in an electrical circuit in just the same way that a Moscrop indicator records variations in the number of revolutions per minute of an engine, or a recording barometer the changes in atmospheric pressure. The illustrations are, of course, diagrammatic, but will clearly show the working of the instrument. Referring to fig. 1, A is a cylinder upon which a paper ribbon, *e*, *e*, suitable for use with a metallic pencil, is wound; the end of the ribbon is carried round the cylinder, B, which revolves freely on a fixed axis, it then passes round the cylinder, C, under D, and then away to any suitable place. E is a small cylinder carried on the rocking lever, F, and by means of the spring, C, caused to press against the cylinder, B, and keep the paper tight. Similarly, C is drawn against D by a spring. H is a pendulum which belongs to clock work not shown in the diagram, but used for rotating the cylinder, D, and thus giving the required movement to the paper. I is a small wheel fixed in any suitable position on the escapement spindle; for example, it is provided with four projecting teeth which are in electrical connection with the axis; as the wheel revolves these teeth press against a spring contact, K, thus completing the circuit from the battery, L, consisting of three Leclanché cells, into the electromagnet, M, round which an intermittent current is therefore sent which may be caused to pass any number of times per minute, according to the number of projecting teeth on the wheel, I. The magnet, M, is on one side of the paper, and its armature, N, is hung by two fine threads, O, from fixed points, P, on the other side, so that it can swing against the poles of the magnet without friction, when attracted by the magnet. Referring now to fig 2, two terminals will be seen at Q, Q′, to these are connected the ends of the circuit in which there is a varying potential to be recorded. From one terminal, Q, a fine high resistance wire, R, made of an alloy of platinum and silver, passes round the small grooved pulley, S, up and round T, back round pulley, S′, fig. 1, and up to terminal, Q′. The principle of the Cardew Voltmeter, patented No. 623, of the year 1883, depends, as will be remembered, upon the expansion and contraction of such a wire as R when, owing to a change of potential in the circuit tested, a varying current is caused to flow in the wire. The piece, U, is a thin metal strip which carries the small pulley, T, and its end, Y, moves in an arc struck from V, by this means very much magnifying the effect of a change in length of the wire, R, it is known as the bow arrangement, and is the subject of a later patent taken out this year. From the point, Y, fine threads pass over small pulleys, of which Z has two grooves, one for the thread, *a*, fixed to a point, *a′*, the other for a thread, *b*, carrying the weight, *c*, fixed to a point diametrically opposite *a′*. The weights, *c*, check any tremor which might be produced at Y.

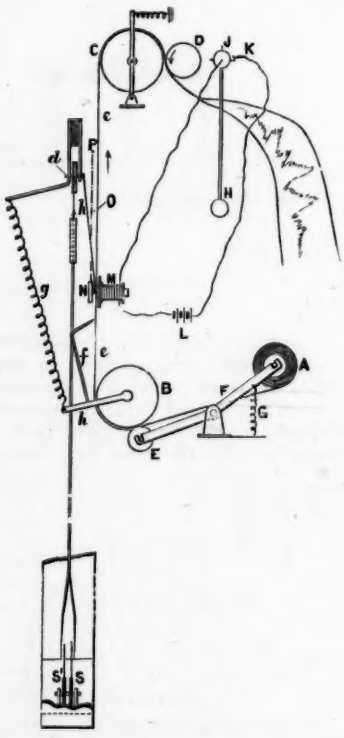



FIG. 1.

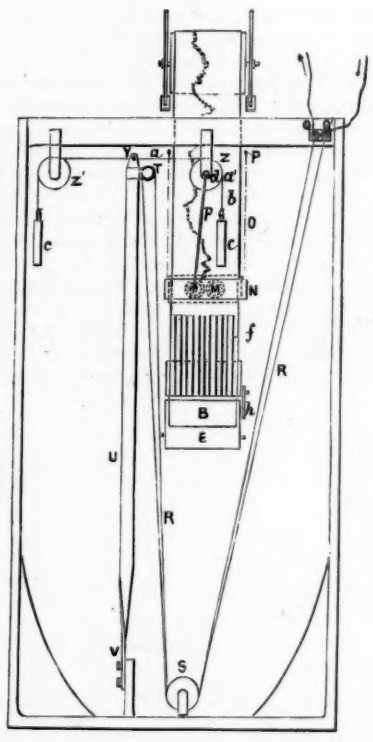



FIG. 2.

Upon the spindle, *d*, to which the pulley, Z, is fast, there is fixed a pointer, *p*, made of some light material, such as aluminium, a small piece of brass, which acts as the pencil is fastened in the end of the pointer which goes between the armature, N, and the prepared paper, *e*, *e*. Upon the arms, *h*, which can rock upon the spindle of B, is fixed a metallic comb of 10 prongs, which is caused to press upon the paper by the pull of the spring, *g*. Suppose the instrument to be set going,

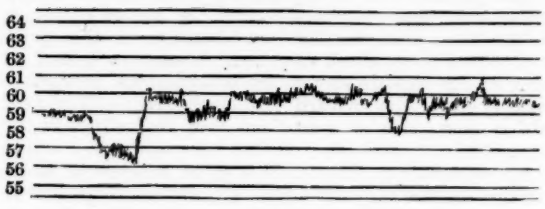



FIG. 3.

the current enters at Q′, traverses the wire, R. which it heats, the point Y moves to the left, and by means of the thread, *a*, the pulley turns and the pointer, *p*, is drawn to the right, the clock is causing the roller, D, to revolve, the paper is travelling up, the prongs make a set of parallel lines upon it, a tooth of I touches K, and a current flows from the cells, L, round the electro-magnet, M; this attracts the armature, N, which presses the end of the pointer against the paper, making a mark. An instrument of this kind has been working for some months continuously at Messrs. Drake and Gorham's, who are making the instruments. We had the pleasure of examining it, and found that an electric clock was being used, but, of course, any clock may be employed. In fig. 3, a view of the paper used is given; the figures represent volts in this instance, registering from 55—64 volts. The instrument may be calibrated by regulating the distance between the prongs of the fork; and a special patent has been taken out for the mode of producing the record.

The main points to be noted are (1) the pointer is absolutely frictionless; (2) an intermittent record is taken by means of a suspended armature; (3) the principle of measuring potential by the expansion of a wire of high resistance; (4) the bow magnifying principle of connecting the wire.

A similar instrument may, of course, be made as a recording ammeter.

## ARC AND GLOW LAMP LIGHTING.

A SHORT time ago an interesting paper on the comparative costs of different kinds of artificial lighting was read before the Liége Society of Engineers, by M. C. Rolland, engineer, of Mons. In the paper were given seven tabular statements, showing the respective cost of lighting by petroleum, coal gas, water gas, magnesium lamps, arc and glow lamps. According to the author, the tables showed that both gas and oil lighting would not at present be supplanted by electricity, as under the most advantageous conditions the electric light cost ·0016 fr. per candle-power, whilst gas lighting at 12s. per cubic metre of gas burnt in regenerative lamps of the Siemens or Wenham type, only cost ·000698 fr. per candle-power, this figure including maintenance and payment to the redemption fund.

One great point that the author has entirely overlooked is, that different conditions prevail in different countries. For instance, the price of gas in certain towns in England ranges from as low as 1s. 10d. per thousand to as high as 7s. In some foreign countries gas is even more expensive than the highest figure charged in this country, as is the case in Spain, Italy, the United States, &c. Then, again, motive power is cheaper in one district than another, especially if water-power is available. M. Rolland too, has not taken into consideration the disadvantages of lighting by coal gas, water gas and petroleum, and amongst which may be mentioned heat, smell, smoke, danger of explosion, fire, &c. These defects are, of course, absent in electric light installations, with the exception of the fire risk, which is reduced to a minimum when the wiring is carried out in an efficient manner.

Three of the tables given by M. Rolland, and which are quoted from M. Heim, are so interesting that we have no hesitation in reproducing them. They show the comparative cost of lighting by different kinds of lamps. The first refers to arc lamps, the second to glow lamps, and the third to the cost per candle hour for different kinds of installations :—

### ARC LAMPS.

| Type of lamp. | Diameter of carbons. | Length of arc. | Angle with the horizon. | Normal C.P. | Electrical work in volt-ampères. | No. of candles per mechanical H.P. |
|---|---|---|---|---|---|---|
| Pieper series lamp ... ... ... | Upper 6·7 mm. | 2 mm. | 0 | 126 | 160 | 433 |
| „ „ „ ... ... .. | Lower 8 „ | 2 „ | 45 | 377 | 153 | 1,360 |
| Schuckert differential lamp ... ... | 10 „ | 4 „ | 0 | 220 | 414 | 293 |
| Siemens & Halske differential lamp ... | 14 „ | ... | 0 | 575 | 918 | 344 |
| „ „ „ „ ... | ... | 4·5 „ | 45 | 3,830 | 912 | 2,310 |

### GLOW LAMPS.

| Type. | Candle-power. | Electrical work in volt ampères. | Number of candles per H.P. | Number of lamps per H.P. |
|---|---|---|---|---|
| Edison lamp, old type ... | 16 | 72 | 122 | 7·6 |
| „ „ new „ ... | 16 | 60 | 147 | 9·2 |
| Swan „ old „ ... | 16 | 66 | 133 | 8·3 |
| „ „ new „ ... | 16 | 56 | 157 | 9·8 |
| Siemens & Halske „ ... | 16 | 52 | 169 | 10·6 |
| Bernstein lamp (Cannstadt) | 16 | 56 | 157 | 9·8 |

### GLOW LAMPS.

| Kind of Installation. | Price per C.P. |
|---|---|
| Private installation for works, &c., of at least 200 lamps, with special motive power ... ... ... ... ... | ·0031 fr. |
| With a surplus motive power ... ... | ·0016 „ |
| Special installation for private individual | ·0047 to ·0062 fr. |

## NEW BOOK.

*Magnetism and Electricity. Advanced and Honours Questions.* Arranged by Prof. JAMIESON. London: Charles Griffin and Company, Exeter Street, Strand.

This pamphlet contains all the advanced and honours questions set at the Science and Arts Department's May examinations during the last eight years, as well as all the honours practical testing questions since these examinations were first instituted at South Kensington in 1886.

**Telephonic Communication in the West.** — The Western Counties and South Wales Telephone Company are rapidly extending their operations in the West, and with a view of popularising the telephone, they have reduced their charges by one-third in all the towns connected with their trunk line.

## NOTES.

**Electric Lighting at Bournemouth.**—The Lighting Committee have reported as to their conference with the Electrical Engineering Company and their visit to the works at Bourne Valley. The committee expressed themselves entirely opposed to granting a monopoly to any one company, and recommended that consent should be given to the applications, for provisional orders, of the Anglo-American Brush Electric Light Corporation and the South of England House-to-House Electric Supply Company, Limited, on the distinct understanding that the terms of the applications shall be approved of by the commissioners, and that no wire shall be carried above ground without special permission. The report was adopted.

**The Lighting of Bognor.**—The Local Board at their last meeting received a communication from the local gas company intimating their withdrawal from the terms on which they proposed to light the town, as they had not been accepted. Mr. Gregory said the idea of lighting their town by electricity had been mooted, and he proposed that the matter should stand over until they heard what advance was going to be made in that direction. This was agreed to.

**The Electric Lighting Question at Leeds.**—The Yorkshire House-to-House Electric Lighting Company, Limited, in consequence of the resolution passed by the Leeds Town Council at its last meeting to defer the question of public electric lighting for six months, has informed the Town Clerk (Sir G. W. Morrison) that they will be glad to hear that the Corporation will not oppose an application by the company for a provisional order. The company's request will be submitted to the Leeds Town Council at its meeting to-morrow, when it will be determined what course shall be taken by the Corporation.

**Gravesend and the Electric Light.**—At a meeting of the Gravesend Town Council on Tuesday, a discussion took place with respect to lighting the borough with electricity. The committee recommended that no consent should be given to any of the companies who had served notices of intended application for provisional orders. Councillor Butchard said the committee did not wish by any means to exclude electric lighting from the borough. As a matter of fact, they were very anxious to get it, but, at the same time, they wished to have the power to make terms with a selected company for obtaining an effective light at a reasonable rate. The committee thought by withholding consent they would further that object, and when the companies applied for powers they would be able to judge of their respective merits. That was the business way of doing the thing, and no one in his private capacity would give his consent to either of these companies until he knew their respective capabilities and what their intentions were. There was no legal necessity for consent to be given before application for a provisional order. Councillor Labourn moved that consent be given to the Municipal Electric Power and Lighting Corporation, Limited, the South of England House-to-House Electricity Company, and the Electric Construction and Maintenance Company, Limited. He said the Board of Trade would see that the interests of the town were guarded before they would grant a provisional order, and it was important that there should be no delay. Margate had given its assent to the Electric Power Company, and Gravesend might safely follow suit. Councillor Cooper did not agree in giving permission to every company that liked to apply, and said it was no good for gentlemen to attend committees if the recommendations were not adopted. After some further discussion, Councillor Labourne's motion was carried.

**Edinburgh Town Council and Electric Lighting.**—A special meeting of the Town Council of Edinburgh was held on Monday, for the purpose of considering the intimations served upon the Corporation by six electric lighting companies, asking powers to supply electricity within the city. Lord Provost Boyd presided. The Town Clerk read the report of the Lord Provost's committee, which recommended the Town Council to adhere to their resolution refusing consent to the applications, to oppose any such application by any of the electric lighting companies, and to postpone, in the meantime, further consideration of the question. The Town Clerk next read letters on behalf of three of the companies that are to apply for powers to supply electricity within the city. Bailie Turnbull said it was quite evident there were difficulties in the way, and he thought they should take no further action in the meantime. They had a great interest in keeping the electric lighting of the city in their own hands. He thought they should reply to the different companies declining to grant their requests, and let the question of future action by the Corporation remain for further consideration. Mr. Kinloch Anderson said he should be disposed to second the motion if Bailie Turnbull would modify the last clause, which said "to postpone in the meantime further consideration of the question." Bailie Turnbull said he would be in favour of deleting the words "to postpone in the meantime further consideration of the question," and to substitute the words, "to remit to the Lord Provost's committee to consider the whole subject and to report." Mr. Kinloch Anderson said they could not recommit it. They must give notice in a day or two if they were to do anything. The Lord Provost said they were too late already. Mr. Macnaughton moved the following amendment :—"That the recommendation of the Lord Provost's committee be not approved of ; further, that the question of electric lighting be recommitted to the Lord Provost's committee, with instructions to confer with the various applicants and arrange as to the conditions on which the consent of the Town Council shall be given or withheld." The objection which he had to the motions which had been submitted was that any one of them necessitated opposition to the companies. Mr. George Auldjo Jamieson seconded the amendment. He was decidedly opposed to all monopoly, he said. He was also decidedly averse to the principle of protection, and he thought that an industry which required to be protected, as the Gas Commissioners thought their industry required to be protected, was doomed. Another reason why he opposed the motion of Bailie Turnbull was that he thought it most undesirable that any delay should take place in affording to the citizens of Edinburgh the benefits of electric lighting. The final vote lay between Bailie Turnbull's motion and Mr. Kinloch Anderson's amendment, the latter of which was carried by a majority of one.

**Portsmouth Lighting.**—As four electric lighting companies have applied for the required consent of the Portsmouth Corporation to a provisional order, the Council will be invited to consider whether it is desirable to obtain a provisional order.

**Northfleet and Electric Lighting.**—At the Northfleet Local Board, on Tuesday, the question of electric lighting was considered. Mr. Tolhurst thought they ought not put anything in the way of electric lighting companies. Mr. Guard said Gravesend had just given consent to three companies who were about to apply for provisional orders. The chairman did not think they should follow Gravesend. Mr. Tolhurst said they did not want to follow Gravesend, but neither did they want to be behind Gravesend. Mr. Topham complained that the electric tramway company had injured the roads. It was decided to rescind a resolution against allowing electric lighting companies at Northfleet.

**Telephone Prospects.**—At the Kent County Council on Thursday, the 7th of November, the South of England Telephone Company applied for permission to erect poles and wires alongside any of the main roads in the county. Sir David Salomons said that the patents would run out in December, and the question was whether the Postal Officials would let them go on. The erection of the poles would make the country hideous. The application was referred to a committee.

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**Electric Light at Rochester.**—The electric light has been successfully introduced into the Council Chamber at the Guildhall, Rochester.

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**Electric Light in Rome.**—A contract has been signed between the Commune of Rome and the Anglo-Roman Gas Society for the illumination of Rome and the suburbs by electric light. One hundred and sixty-seven electric lights will take the place of 706 gas lights, at an increased expense of nearly 26,000 francs annually.

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**Cheaper Electric Lights.**—The Boston Walworth Company has recently increased its capital from £15,000 to £105,000. The company will make an offer to the Board of Aldermen to light the streets of the city at 45 cents. a lamp per night, which is 20 cents. cheaper than the present contract, and would make a saving of £50,000 a year.

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**Electric Light at West Bromwich.**—The Town Council will apply for a provisional order.

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**York.**—The subject of electrically lighting this town will be discussed by the Town Council on December 9th.

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**Underground Conductors.**—Mr. Edison is firmly convinced that even if the high tension wires in America are put underground they cannot be successfully or safely operated. It would be interesting to learn his opinion of the Deptford scheme, with Ferranti's cables, which seems a very long while coming to the fore.

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**Cable Ship Appointment.**—Mr. Maynard Dodd, an "old boy" of Hutcheson's Grammar School, Glasgow, and the best student in electrical engineering (telegraph branch), session 1887-88, in the classes conducted by Prof. Jamieson, Glasgow, and West of Scotland Technical College, has just been appointed assistant electrician to the Anglo-American Telegraph Company. He will shortly leave London on board the cable ship *Minia*, on which Captain Trott and chief electrician Hamilton are at present taking 100 knots of their new patent untwistable cable for a deep-water job in connection with one of the trans-Atlantic lines. Mr. Maynard will have an opportunity of getting excellent practical training under Mr. Hamilton and that famous cable ship commander Captain Trott.

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**National Telephone Electrical Society** (Birmingham Branch).—On Friday evening, the 8th inst., Mr. Alfred Coleman, M.I.E.E., the President, delivered an inaugural address on "The Future of the Telephone." The speaker briefly showed that the telephone had now taken its place among the necessities of life, and success in the future was therefore assured. He pointed out to the members the necessity of keeping ahead of the times, and directions in which they might exercise their minds with a view to introducing improvements. The meeting was thoroughly appreciative, and the society promises to have a successful session.

**Insulating Composition.**—The Telephone Company of Zurich is supplying a new insulating cement for electrical apparatus, for which the following advantages are claimed. Its insulating property is equal to that of porcelain; it is hard as stone, but not brittle, and it is not acted upon by moisture, acids, or heat.

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**A New Soldering Flux.**—A new resinous soldering flux (patented) has recently been brought out by Mr. J. N. Watkins, of Eccles, Manchester. The flux is a liquid, about the consistency of thin varnish. As it contains no alkali or acid, either free or combined, no corroding effects whatever are produced by its use. With the new flux the solder will flow (as we have verified by experiment) with great freedom, a point which is of the greatest importance. For telegraph and electric light work the liquid must prove very valuable.

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**A New Canadian Cable.**—The *Montreal Shareholder* says:—"We are pleased to learn that the Canadian Atlantic Cable project, in which Mr. R. R. Dobell, of Quebec, has taken such a lively interest, has been put into practicable shape. The fact that an English firm has engaged to make the cable, lay and guarantee it for $1,500,000, is an indication that lower cable rates will prevail by this line, a feature which the prospectus of the company lays stress upon. With an outlay one-third that of the Commercial Cable, which is the cheapest yet laid, and which cost $4,000,000 to make and lay, the new company will be able to do business profitably at lower rates than any of the other companies. We trust that it will be carried to a successful issue without delay, in order that we may have a Canadian Press service which will give us the latest news from the other side, without the adulteration and discolouring which is necessary to tickle the palates of those Anglophobes for whom it is now specially prepared."

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**Obituary.**—We regret to hear of the death, at the age of 63, at Berne, after a long illness, of M. Louis Curchod, director of the International Bureau of the Telegraphic Union. As Central Director of the Swiss Telegraphs, M. Curchod took part in the preparation of the first international telegraphic conventions. He was appointed to represent Switzerland at the Paris International Telegraphic Conference in 1865, and rendered the greatest assistance at that first meeting of the heads of the European telegraph offices, among whom he took a prominent place, which he held till the time of his death. The formation of the International Bureau of Telegraphy administration (one of the results of the 1868 Congress), the management of which was handed over to the Swiss Government, was directed by M. Curchod. He took part in the telegraphic conferences of Rome in 1871, of St. Petersburgh in 1875, of London in 1879, and of Berlin in 1885, and contributed largely to the progress realised by those different assemblies. Among other honours which had been conferred upon him, he was promoted to the dignity of Grand Officer of the Order of St. Stanislas of Russia. He was also a Commander of the Order of the Royal Crown of Prussia, an Officer of the Legion of Honour, a Commander of the Order of the Royal Crown of Italy, a Grand Officer of the Order of Francis Joseph of Austria, &c.

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**A Novel Way of Exhibiting.**—Germany is about to carry out a very novel enterprise. An enormous German Lloyd steamer is about to be fitted up into exhibition rooms, in which will be displayed samples of every article that will illustrate the industries of Germany. The vessel has three decks, and there will be eight large exhibition rooms. There will, in addition, be dining, smoking, and music rooms upon the promenade deck, and the ship will be lighted with electricity, and heated with steam. It is going round the world, and will stop at 80 different ports. The *Great Eastern* was once rigged for a similar purpose, but the show was a stationary one.

**The Spite of Gas.**—The following extract is from the *Evening Telegraph*, Dublin, dated the 12th inst. :—"A fire of a most unusual kind occurred in Messrs. Powell's establishment, in William Street, on Thursday evening. The immediate cause of the fire was an old composition gas pipe (which we presume must have been leaking) went on fire, and very soon set fire to the electric light wires, which passed near it, melting off the insulation, which is itself a most inflammable substance, and in turn would have set fire to the surrounding woodwork but for intervention of a painter, who dashed a bucket of water on the burning matter, he receiving, in turn, as a reminder that he was dealing with electric fluid, a smart shock from the current running back along the water to his hands. We understand that as a result of this accident Messrs. Clerry and Co.'s and Messrs. Pim Brothers' establishments were deprived of their electric lights for about half an hour while the wires were being cut away from Messrs. Powell's establishment."

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**Old Students' Association.**—The presidential address will be delivered by Mr. W. E. Sumpner, D.Sc., on "Some Peculiarities of Alternate Currents," illustrated by experiments, on Tuesday, the 19th of November, 1889.

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**Institute of Electrical Engineers Students' Meeting.**—The first meeting of the latter part of the session took place on Friday evening last, Mr. A. H. Dykes in the chair. A lively and instructive discussion took place on "The different systems of distribution being employed in London at the present time," in which the following gentlemen took part :—The Chairman, and Messrs. Barton, Childs, Horn, Jacob, Müller, Poynton and Walker. The next meeting will be held on Friday, November 22nd.

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**Tramway Propulsion.**—The Plymouth Tramway Company is about to complete and equip the line for which renewed parliamentary powers have recently been obtained, and is prepared to receive proposals for traction by cable or electricity. Applications should be made before December 5th, by letter only in first place, to the Secretary, Plymouth Tramway Company, care of Messrs. Walter Webb and Co., 28, Queen Victoria Street, London, E.C.

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**Telegraph Stores.**—The North-Eastern Railway Company requires a supply of the following articles during six months ending June 30th, 1890, delivered carriage paid at the Stores, at York :—1, Telegraph apparatus ; 2, telegraph wire and line stores.

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**The Electric Lighting Act.**—In view of the ensuing Session of Parliament, the Board of Trade has, it is stated, already received over 300 applications for provisional orders for the electric lighting of various towns in Great Britain, the whole of which, if granted, will require the sanction of Parliament next Session before they can become operative. In some cases they will be allowed to proceed without opposition, but in others local authorities intend stepping in. Preference will be given to these when their intention to supply electrical energy is *bonâ fide*.

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**Margarine alias Bosh.**—Our readers will find something to amuse them in perusing the objects with which the "Batava" Company has sprung into existence. "Greased lightning" will be as nothing compared to buttered electricity.

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**Electric Pumping and Hauling Plant.**—Messrs. Immisch & Co. are issuing invitations for the inspection of their electric mining apparatus at St. John's Collieries, Normanton, Yorkshire.

**The Proposed Electric Tramway between Bournemouth and Poole.**—This matter has again come before the Bournemouth Commissioners, and on the recommendation of the Roads and Works Committee it has been decided to withhold permission for the present. The Bournemouth and Poole Tramway Company have given notice to the Hants County Council of their intention to apply for a Provisional Order.

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**The Sawyer-Man Decision.**—Speaking of the recent decision, the New York *Electrical World* says :—Very great interest attaches to the Sawyer-Man decision. Judge Bradley's decision, in which the broad claim of Sawyer-Man to the fibrous filament lamp is upset, invalidating the patent, is in many respects a remarkable one. "We are clearly of opinion," says the judge, "that neither Sawyer and Man nor Edison can maintain any just claim to the exclusive use of charcoal generally in any form as an incandescing conductor in an electric lamp." In fact, the two joint inventors did not start out with the idea of securing any such monopoly, he contends, but desired simply to patent the carbon arch ; and he so reads the evidence as to intimate that an illegitimate effort was made when the subject matter was subsequently amended. But Judge Bradley is not satisfied with this, and goes on to define what the real invention in the practical, successful commercial incandescent lamp is, and this in a very plain way he describes as the filament of high resistance invented, perfected and patented by Mr. Edison. Of this he says, as Judge Wallace said of Reis in regard to the Bell telephone, "it is undoubtedly the great discovery in the art," without which "electric lighting would never have become a fact." This is clearing away the underbrush with a vengeance, and leaves to view, as never before, the giants of the forest. Judge Bradley's decision is, it must be frankly admitted, a very positive support to the Edison claims, and, if sustained in further litigation, might possibly create an Edison lamp monopoly in America of the kind already existing in England through the verdicts of the courts. But the question here arises as to the effect upon the Edison patents of the much-discussed foreign limitation. Should the rulings on that issue be sustained, the incandescent lamp is practically public property to-day ; but if it be held on review that an American inventor should not be made to suffer in this manner, then Mr. Edison stands to win pretty well all along the line. Such is, in brief, the situation as the decision makes it.

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**Electrically Opening Railway Gates.**—A test was made a short time ago of the Toulmin Electrical Railway Company's newly patented gate at Woodbrook Station, on the Western Maryland Railroad, U.S.A. A special train, which conveyed the party to the station, ran over the plates, which are some distance from the gates. The gates were closed or opened according as the train approached or departed from the crossing. The trials were satisfactory.

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**Uncertainty.**—The *Western Electrician* says :—"A second murderer, Charles McElvaine, has been sentenced to death in New York State under the new law providing for electrical executions. No mention is made of electricity in the sentence imposed by Judge Moore. The Court merely said : 'And that during the week beginning Monday, December 9th, next hereafter and ensuing, you be executed and put to death by the agent or warden of said Sing Sing prison in the mode and in the manner prescribed by the statute or laws of this State, and the warden of that prison is directed and commanded to do the execution according to this sentence, and according to law.' In the case of the first murderer, Kemmler, Judge Childs sentenced the prisoner to 'suffer the punishment of death to be inflicted by the application of electricity.''

**Birmingham Exhibition.**—We are informed that our references, in last week's issue and in that of the week previous, to the awards and the closing of the above Exhibition were incorrect. It is with pleasure we learn the fact, but our imformation, we may state, was derived from the Birmingham Press.

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**A New Insulation.**—Our American contemporary, *Modern Light and Heat*, states that a patent has recently been granted to the Gould and Watson Company, of Boston, for the use of flake mica in electrical conduits. The system briefly consists of a box tube or electrical conduit, into which the wires are drawn, the conduit itself being filled and packed with flake mica. The usual ridiculous claptrap statement is made that the system "is destined speedily to work a revolution, &c." We should like to know whether there ever has been a case known in which predictions of this kind have been verified.

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**Burton-on-Trent.**—The Council will oppose all companies, and apply for an order themselves.

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**Edinburgh Electrical Exhibition, 1890.**—A deputation, consisting of Sir George Chubb, and Messrs. A. R. Bennett, Faithfull Begg and Exton, with Prof. Beare, waited on the Council of the Institution of Electrical Engineers on November 4th, for the purpose of inviting the Institution to hold a special meeting in Edinburgh next year, during the run of the Exhibition, and to ask advice on the subject of awards and general matters connected with the undertaking. On the deputation retiring, the Council considered the questions raised, and resolved that a meeting of the Institution be held in Edinburgh next year, either shortly before or after that of the British Association. The project of a Congress, which had also been suggested, did not meet with the Council's approval. On the question of awards, the Council recommended the Exhibition authorities to properly test and certify the merits of exhibits, but not to award medals.

In addition to the names of the gentlemen composing the London Committee, which we published in our last, the following have been added :—Sir John Pender, Sir Jas. D. Linton, Sir Saul Samuel (Agent-General for New South Wales), Sir Graham Berry (Agent-General for Victoria), Sir Francis Dillon Bell (Agent-General for New Zealand), Col. R. Raynsford Jackson, Capt. E. J. Bax, Major Flood Page, W. Fox, Esq., C. A. Gosnell, Esq., John Noble, Esq., John R. Haswell, Esq., Leo Atkinson, Esq., J. C. Bennett, Esq., F. Faithfull Begg, Esq., J. Adam Watson, Esq., Walter Hill, Esq., A. Savill Tomkins, Esq., C. M. Kennedy, Esq., C.B., George Hodgson, Esq., Geo. H. Hodgson, Esq., J. C. Chubb, Esq., Samson Barnett, Esq., and Philip A. Scratchley, Esq., M.A., A.I.C.E.

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**The New York Electric Club.**—The attractive, well-lighted parlours of the Electric Club, New York, were filled with members and invited friends on Thursday evening, October 17th. Dr. Leonard Waldo, of Bridgeport, Conn., electrical engineer of the Aluminium Bronze Company, formerly of the Yale Observatory, gave an address on "Some casual ideas concerning the requirements, possibilities and risks of the electric club." The meeting was a most pronounced success, and will undoubtedly be followed by many more of a similar character.

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**Telephony in Russia.**—The *Daily News* correspondent says it is reported from Russo-Polish frontier districts that the different railway stations are being connected by telephone, the line of which connects all the military garrisons near the frontier.

**Failure of Electric Light.**—It is said the electric light which is in general use at Temesvar, Hungary, failed last week amidst great excitement. The accident is attributed to faulty connection of the wires. A fire broke out, on this account, in the building occupied by the Chamber of Commerce, and from the same cause the subterranean wires melted under a private house.

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**Mason College Engineering Society, Birmingham.**—The annual meeting of this society was held in the Mason College on Wednesday, October 30th, Prof. R. H. Smith, President, in the chair. The secretary presented the annual report and balance sheet, which showed the society to be in a very satisfactory condition. There are 89 members on the roll. After the election of officers for the ensuing year, a paper was read, entitled, "Electrical Novelties at the 1889 Birmingham Exhibition," by Mr. E. L. Joseph.

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**Electricity in the Russian Navy.**—The Russian Government has decided to spend a sum of 650,000 francs for the inauguration of the electric light aboard the ships composing the squadrons of the Black Sea and the Baltic Sea.

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**The Electric Light at Llanelly.**—It is said much interest is felt in the coming attempt to illuminate the streets and shops by electricity. At Tuesday's Board of Health meeting some severe comments were made on the Llanelly gas, and unless this improves, the new light will be hailed with exceeding great joy.

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**Derby.**—The council has decided to apply for a provisional order for supplying the electric light.

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**Burton Refuses Consent.**—The authorities will oppose all comers who wish to supply the light.

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**Tunstall.**—The Board of Health will refuse consent to companies unless such terms and conditions are introduced as will facilitate the purchase from the company on advantageous terms.

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**Yarmouth.**—The Corporation will apply for powers to supply the light.

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**Cheltenham and the Supply of Electricity.**—The Council has had applications from three companies to supply electricity, but has resolved to oppose their obtaining the necessary powers.

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**Engineering Society, King's College, London.**—At a meeting of the above Society on October 22nd a very interesting paper was read by Mr. J. C. Paulson on "Modern Telegraphy." The author commenced with a brief description of some of the experimental lines as early as 1823. He then dealt with line wires, overhead, underground, and submarine cables, describing some of the most important, and methods of insulation and testing for faults. The author then passed on to the consideration of telegraphic instruments, describing in detail the single and double needle receivers, acoustic telegraph and Morse sounder, the Morse printing telegraph, Breguet's dial receiver and transmitter, and Thomson's syphon recorder, alluding to the modifications of the latter instrument for very feeble currents on long cables, in which the ink and paper are oppositely electrified by an induction machine, causing the ink to flow in a series of fine dots.

**Eureka: 5,000 Volts!**—We have received the following letter, which was too late for our correspondence columns last week; whether it should rank as a humorous recitation or serious production we can scarcely say: "I feel constrained, in view of the future of our glorious science, to write to you to inform you and your readers that lighting has been done on the transformer principle, within the last few days, from a dynamo generating 5,000 volts, and maintained running for several hours on a circuit of some hundred or two hundred lamps. The results in all respects were most encouraging, and although it is too premature to state with any accuracy the further extent to which the voltage may be pushed, it is not, I think, too sanguine a view to take of the position to say that 10,000 volts will be as easily controlled as the 5,000. This is an event in electric generation, and the forerunner of who knows what other achievements! The Marquis of Salisbury, at the recent dinner of Electrical Engineers, threw out the suggestion that people might yet be doing work in their own homes which now requires to be executed at the factories, because steam energy cannot be economically transmitted. These may be too sanguine hopes; yet we must push on, and we may be able some day to convey the coal energy from the pit's mouth to extreme distances. The baby analogy of the noble Marquis is too good not to be remembered. The electric baby is too small even now for the general conception or observation; but wait—the electric elephant is coming, and then what a shout, something even more than a *gas* explosion!—JAMES C. RICHARDSON."

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**New York's Experience.**—The American *Electrical Review* says:—"The experience of New York, in being so cut off from electric illumination, has served to awaken other cities to the chances of a repetition of such a calamity in their midst. Boston, although remarkably free from accidents, considering the number of overhead wires and the introduction of street railways on the overhead wire system, has nevertheless taken steps, through the electric exchange, to have the authorities remove 'dead' and 'tramp' wires, and has also taken steps to call to the attention of the authorities the necessity of keeping politics out of the question in appointing electrical inspectors and commissioners."

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**A Statue of Ohm.**—A statue of the famous physicist Ohm is to be erected at Munich. Contributions amounting to about 24,000 marks have been collected in Germany, England, France, Austria, Italy, &c. Should there be a surplus, another monument will be erected in his honour at Erlangen, where he was born upwards of a century ago.

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**Lecture on the Telephone.**—A lecture of unusual interest was recently delivered by Mr. Alfred Coleman, general manager of the National Telephone Company, Birmingham, in connection with the Aston Free Library Lectures. An exemplification of the practical working of the telephone was given, the platform being for the time converted into a telephonic exchange, two instruments fixed at the lower end of the room representing the speaking stations of two subscribers. Photographs of all the principal exchanges in Great Britain were shown by the lime-light, and at the conclusion of the lecture a practical demonstration was given of the capabilities of the telephone for transmitting sounds over long distances, a cornet solo played at Bradford being distinctly heard by the whole audience in the lecture-room at Aston.

**The Julien Electric Traction Company.**—This New York company has issued the following manifesto:—"To stockholders—In view of the recent decision of Judge Lacombe, assigning to this company a definite and specific process of making its storage batteries as distinguished from other methods, we have concluded to temporarily suspend the operation of our cars in this city pending the manufacture of batteries according to the method prescribed by the Court. The factory at Camden will expedite the manufacture of batteries so as to enable us within a few weeks to resume operations. It is gratifying to know that the Court has finally determined the respective rights of this company and the complainants as to the methods to be employed by each in making batteries, more especially as the method we shall now employ is not only practical, but, in the opinion of such competent experts as Prof. Cross, of the Institute of Technology; Prof. Brackett, of Princeton College; and Prof. Edward Weston, of Newark, is superior to the method awarded to the complainant."

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**The Electric Light at the Gaikwar's Palace.**—The whole palace has been fitted up by Messrs. Siemens and Company with the electric light. The interior is lit with 215 16-candle-power incandescent lights. The large hall is illuminated with two large 12-light electroliers made in bronze and lacquered work, while the light is softened and diffused by dioptric shades. Single lights are also pendant from the ends of the columns of the gallery. In some of the other rooms are 3 and 4-light electroliers, made in a variety of pretty designs to suit the surroundings. In two of the bedrooms the mirrors have been specially fitted with brackets, which will permit of their being shifted from one room to another; and there is introduced a hand lamp, which can be moved about at pleasure. An important feature in the installation is the complete arrangement of switches and safety fuses. In many of the old systems there was always the danger of the wires becoming overheated and setting fire to the building in which they were laid; but it is claimed that with improvement which Messrs. Siemens have introduced, this is impossible.

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**Maltese Lightning Commission.**—The Deputy Governor of Malta has appointed a commission for the purpose of enquiring into and reporting upon the circumstances attendant upon the death by lightning which took place near Rabato, Malta, on the night of the 29th ult., and with reference to the danger or inconvenience which may, in certain cases, result from telegraph or telephone wires fixed against inhabited buildings. The members of the Commission are:—The Hon. G. C. Schinas, Ph., D.C.E., Superintendent of Public Works; Prof. S. L. Pisani, M.D., Chief Government Medical Officer; Captain Middlemass, R.E.; Prof. H. Magro, M.D.; John McGill, Eastern Telegraph Company.

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**The Supply of Coal.**—The President of the Manchester Geological Society considers that the supply of coal will have run out in the year 2118. Meanwhile, there will be a constant rise in the price, which will materially affect those industries dependent on steam power.

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**Telegraph Poles Wanted.**—Tenders are asked for a supply of creosoted Swedish or Norwegian fir poles of stout specification for delivery in Scotland during next six months, for the National Telephone Company. Particulars may be obtained on application to the secretary of the company, Oxford Court, Cannon Street, London.

**The Erection of Telephone Poles at Bournemouth.**—The Bournemouth Improvement Commissioners had before them at this month's meeting an application from the telephone company, seeking permission to erect some poles near the Common. Mr. George thought that the wooden poles were very unsightly, and a great disfigurement to the town. He proposed that permission should only be accorded in future on condition that iron standards were substituted. Mr. George's suggestion was adopted.

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**A Borough Engineer on Electricity.**—Mr. H. Percy Boulnois, C.E., Borough Engineer of Portsmouth, in the course of his inaugural address as President of the Portsmouth Literary and Scientific Society, said it was curious to see how much more extensive was the use of electricity in the United States than in England, for whereas here there were not a hundred motors worked by the transmission of electricity from a central station, there were upwards of six thousand such machines in America. He referred to an application of electricity which might be seen in the electric railway on Ryde Pier. This was a very curious illustration of the transmission of power to a distance. The coal was consumed at the gasworks. The gas product of this consumption was carried in a pipe to the shore end of the pier. Here an Otto gas engine worked a dynamo, which sent the power down the line aud carried the passengers from one end of the pier to the other. He next showed how rapidly the telephone had grown in public favour since the original invention was only exhibited by Prof. Bell at the Philadelphia Exhibition in 1876. The phonograph, he said, had hitherto remained only a scientific toy, but improvements were now being made which would render it valuable.

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**As Others See Us.**—Mr. T. D. Lockwood, on October 15th, read, before the American Institute of Electrical Engineers, a chatty and interesting paper on a "Transatlantic Trip." Speaking of the British telegraphs, he says :—"The facilities for telegraphy in the United Kingdom are wonderfully complete, and I found no place too small for a telegraph office ; moreover, in my opinion, telegraphy is there cheap, in spite of the fact that the address and signature has to be counted in and paid for. The dynamo does not appear to be employed as a source of telegraphic currents, and here I think the British telegraph system is a little behind the times. Yet, as far back as 1873, I understand that Mr. Preece experimented with the Gramme machine for this purpose, but found it too unsteady for the Wheatstone automatic instruments. Although, generally speaking, electric lighting is a thing of the future, isolated house lighting is, however, well advanced. Inquiries which I made proved that this branch of incandescent electric lighting, which has overflowed upon the steamships and boats, is very popular. In the several examples of it, which came under my personal notice, the electricity is drawn from secondary batteries, which are, during the day, charged by a dynamo. Long line telephone work in Great Britain is, of course, limited by the size of the island, and by the peculiar relative position of the large towns. I found very good talking between Birmingham and the several towns of Sheffield, Derby and Nottingham ; between Glasgow and Edinburgh and Dundee ; and especially fine from Sunderland to points upward of a hundred miles distant. For these latter distances circuits had to be artificially made up. In London there are necessarily many central telephone stations. As to electrical construction outside I may say, without hesitation, that the average is far above ours, whether telegraphic, telephonic, or otherwise. The poles are no longer than are necessary, are uniformly well trimmed and painted, and above all, are well stayed.

**An Electric Car on Fire.**—The *Electric Age* of New York says gross neglect on the part of one of the promoters of the Thomson-Houston motor systems in allowing unskilled persons to handle its apparatus caused an electric street car in Atlanta, Ga., to be fired while crossing the long trestle, about a mile from that city, on October 25th. The car was crowded with passengers at the time, and, in the scramble to escape, many persons were injured. The fire probably originated in a hot journal, but that fact will not lessen the condemnation of electric systems in general by the public at large. In fact, advices from Atlanta are to the effect that the accident has crystallised public opinion that the electric cars must be placed in the hands of intelligent persons or removed from the streets. Economy can be carried too far by motor as well as electric light companies, it appears. Electric light companies wired buildings with poorly insulated conductors until the Board of Underwriters were compelled, for their own protection, to demand reforms ; the overhead wires were strung along the streets, without the slightest regard to public safety, until the clamour for their removal became irresistible, and now the electric motor business is to be handicapped by the penny-wise-and-pound-foolish policy. Truly, economy is electricity's worst enemy.

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**The Lighting of the "Three Towns."**—It is said there will be considerable competition in the lighting of Plymouth.

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**Society for the Encouragement of Arts, Manufactures and Commerce.**—We have to hand the sessional arrangements, and note with satisfaction that very good lectures will be delivered during the winter months. In the series of Cantor Lectures we see Prof. Silvanus P. Thompson will deliver four lectures on "The Electro-magnet."

## NEW COMPANIES REGISTERED.

**Taylor and Challen, Limited.**—Capital, £40,000, in £10 shares. Objects : To acquire the business of Messrs. Taylor and Challen, of the Derwent Foundry, Constitution Hill, Birmingham, and to trade as civil, consulting, mechanical, electrical, and general engineers. Signatories†(with 1 share each) : *Joseph Taylor, *J. S. Taylor, Miss E. A. Taylor, *S. W. Challen, *W. B. Challen, Mrs. S. W. Challen, all of Birmingham ; J. C. Bayliss, Handsworth. The signatories denoted by an asterisk are the first directors ; qualification, £500 in share capital ; the company in general meeting will determine remuneration. Registered 7th inst. by Crowder and Vizard, 55, Lincoln's Inn Fields.

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**Lange and Company, Limited.**—Capital £10,000, in £50 shares. Objects : To acquire the business of Lange and Co., of Boulogne-sur-Mer. To supply electric light and power in France or elsewhere. Signatories (with 1 share each) : *F. M. T. Lange, Boulogne, electric engineer ; D. F. Adamson, Surbiton, electrician ; Mrs. E. Tabor, 29, Westbourne Terrace ; S. S. Harper, Lloyds ; *G. H. Verity, 31, King Street, Covent Garden ; J. W. Adamson, 26, Billiter Street, E.C. ; S. Thomson, 165, Fenchurch Street, solicitor. The subscribers denoted by an asterisk are the first directors ; qualification, 1 share. Mr. F. M. T. Lange is to receive a remuneration of £250 per annum, and 10 per cent. of all profits dis-

tributable after payment of 10 per cent. per annum dividend. Registered 8th inst. by Bonner, Wright and Co., 165, Fenchurch Street.

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**"Batava," Limited.**—Capital £100,000, in £1 shares. Objects: To carry on, in Holland, the business of manufacturers of margarine, dairymen, ice merchants, tinsmiths, waterworks proprietors, electricians, electrical engineers, suppliers of electricity and of the electric light. Signatories (with 1 share each): *W. Salmonski, Nijmegen, Holland; C. Scott, St. Albans; J. Gardner, 81, Gracechurch Street; *H. S. Lidstone, 37, Great Tower Street; J. A. Gardner, 81, Gracechurch Street; A. H. Boxall, 37, Great Tower Street; S. B. Wiatt, 37, Great Tower Street. The signatories denoted by an asterisk and E. Morris, F. Mason, A. R. Dyer, C. F. Huffman, D. Evans, and E. S. Boord are the first directors; qualification, £500 in shares or debentures. Remuneration will be fixed at the statutory meeting. Registered office, 81, Gracechurch Street. Registered 9th inst. by Baker and Nairne, 6, Crosby Square.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Keswick Electric Lighting Company, Limited.**—The statutory return of this company is made up to the 15th August. The nominal capital is £5,000, in £1 shares. The shares taken up are 2,265, upon which 10s. per share has been called, the calls paid amounting to £1,132 10s. Registered office, St. John Street, Keswick.

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**Medical Battery Company, Limited.**—The statutory return of this company is made up to the 5th September. The nominal capital is £100,000 in £5 shares, the whole of which are taken up. 19,993 shares are considered fully paid, and the full amount has been paid upon the remaining seven shares. Registered office, 52, Oxford Street; C. R. Sharman, secretary.

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**Crompton Electric Supply Company of Australia, Limited.**—The statutory return of this company, made up to the 26th ult., was filed on the 4th inst. The nominal capital is £50,000, divided into 9,500 "A" and 500 "B" shares of £5 each. The shares taken up are 2,895 "A," upon which £2 per share has been called, and 500 "B" shares issued as fully paid. The calls paid, including £120 payment in full amount to £3,070, and unpaid to £2,840. Registered office, Mansion House Buildings, 4, Queen Victoria Street.

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**Electrical Power Storage Company, Limited.**—At a special general meeting of this company, held at 4, Great Winchester Street, on the 16th ult., the following resolution was duly passed, viz:—"That the company be wound up voluntarily under the provisions of the Companies' Acts, 1862 and 1867, and that John Irving Courtenay, Esq., of 4, Great Winchester Street, London, E.C., managing director of the company, be, and he is hereby appointed liquidator, for the purposes of such winding up." This resolution was confirmed on the 1st inst., and was duly filed on the 4th inst.

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**Halifax and Bermudas Cable Company, Limited.**—The statutory return of this company, made up to the 1st ult., was filed on the 8th ult. The nominal capital is £50,000 in £5 shares, the whole of which are taken up. The calls paid amount to £49,965, and unpaid to £35. Registered office, 33, Old Broad Street.

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**Woking Electric Supply Company, Limited.**—The statutory return of this company, made up to the 9th ult., was registered 11th ult. The nominal capital is £20,000 in £5 shares. 467 shares are taken up, of which 400 are considered fully paid up. Upon 60 shares there has been a call of 5s., and upon 7 shares a call of £1 5s., the calls paid amount to £23 15s. Registered office, Board School Road, Woking.

An agreement of 11th July with Messrs. Renshaw, King and Company, of Kidsgrove, Stafford, states that the company has received from the said firm a certain tender to provide the necessary funds for payment of formation and registration expenses, to provide a freehold site for the works, to erect the plant, machinery and station outfit for generating electricity for 1,500 16-candle-power incandescent lamps, and to erect the necessary buildings for the same; and to provide and erect four miles of pole lines, including poles, insulators, supply and service cable transformers, &c., required for the effective supply of electricity, with not less than 40 poles per mile, and to maintain the works in good order for one month after completion, for the sum of £10,000 in fully paid shares. The agreement provides for the issue of the said shares.

## LEGAL.

**United Telephone Company v. Mitchell.**—This action came before Mr. Justice Chitty, in the Chancery Division on Saturday last, on motion for judgment in default of defence. Mr. Micklem stated that the defendant had put in no pleadings. Particulars of breaches of patent had been delivered by the plaintiffs, containing the charges against the defendant. A draft order had now been prepared, which the Court was asked to adopt, in the form made in previous cases of a similar character. Costs, charges and expenses were asked against the defendant in the matter. Order accordingly as asked by plaintiffs.

## CITY NOTES, REPORTS, MEETINGS, &c.

### The Swan United Electric Light Company, Limited.

THE ordinary general meeting of this company was held on Wednesday at Cannon Street Hotel.

The Chairman, Mr. J. S. Forbes, said: After referring to the figures given in the report published in the REVIEW last week that probably there had been a very large diminution in the volume of the business, they had parted with patents of considerable value to Continental companies of which they were members. In virtue of the amalgamation with the Edison Company they had received shares to the value of their patents, and were owners of 40 per cent. of the undertaking, the result had been that a dividend had been declared on December 31st amounting to 6 per cent. It was the first occasion on which the directors of Edison and Swan had felt justified in apportioning any amount of the profit of their undertaking for the purposes of dividend. For a number of years that company had to write down losses incurred in the initiation of the business, and until that had been done they could not declare any dividend. That made a dividend of 10 per cent. on the Edison and Swan shares, which, as they knew, they held a large number. Of course, the result would not have been satisfactory had it not been for the holding which they had in the Edison Company and Companie Générale. The long and short of the matter was that the Swan Company virtually existed as owners of shares with two companies. The French company had an admirable factory, and there was every reason they would create a business on the Continent like they had built up in England. They (the Swan Company) had only

one factory, the lease of which would expire in June next. Before that time they would have to consider whether they could go on with it. Meanwhile it was necessary they should go on with the work as the lamp was well thought of in Germany. Judging by the sale of the lamps, it was a bad business; but doubtless the expenses would be reduced next year. He might just mention the company had litigation going on in Germany, which was a very slow process. They had a balance of £21,000, which represented the available profit which could be recommended for division, although, in the face of possible actions, it would be wise to retain a portion. It was the first meeting at which the directors had had the pleasure of declaring a dividend, and the shareholders could imagine how they felt as compared with previous years. It was, in fact, a red-letter day. He had little doubt that there had been as much brains expended upon their small capital as upon many millions spent in bigger enterprise. Their future depended largely upon the investments in the two companies. The Edison Company was well-nigh invulnerable in the patents; the efficiency of the lamps increased day by day. He begged to propose that the report and accounts be adopted.

Mr. F. R. Leyland seconded the motion, which was adopted unanimously.

The Chairman then proposed a dividend at the rate of 6 per cent., which was carried.

On the motion of Mr. F. R. Leyland, seconded by Mr. Swan, Mr. Forbes was re-elected a director, as also Mr. Batt.

Messrs. Wilton, Jones & Co. were then re-elected auditors at a remuneration of 50 guineas per year.

## The Western and Brazilian Telegraph Company, Limited.

THE eighteenth ordinary general meeting of this company was held on Wednesday at Winchester House, in accordance with the notice given in the report published last week, which shows the present position of the company with regard to the Brazilian Government. Mr. W. S. Andrews occupied the chair.

The Secretary, having read the notice convening the meeting,

The Chairman said his task was not quite so satisfactory as previously, as he had a matter to deal with of considerable importance. After dealing with the accounts given in the report, he went on to deal with the subject of the loop cables. Although they had, from the competition of the Brazilian Government, suffered, it was not so material as might have been. The report would have prepared the shareholders for the statement which he would make. The decision of the Brazilian Government was that the company was not to be allowed to lay cables on those routes which they conceived to be necessary for the best interests of the service. They did not intend to say that the lines could not be maintained without the loops, because they had always done so. Still they believed they were entitled to lay them to keep the service in as efficient a manner as possible. In 1873 the Brazilian Empire, occupying a most isolated position, resolved that a concession should be given to establish communication between Brazil and Europe, which concession was opposed by the Director-General of Brazil, who thought that the Government might themselves overcome the obstacles and establish a system. As this would take a very considerable period a concession was granted to this company to lay not only a line to Europe, but also along the Brazilian Coast, thus getting much earlier the benefits which results from connection with the civilised world. The finishing of the cable was greeted by public enthusiasm, and the Emperor himself came down to the beach and assisted in drawing up the end of the cable. However, when they wanted to strengthen the cables the company were informed that they could not lay a loop cable without a further concession, which is in direct opposition to the original concession. He considered the advice offered to the Brazilian Government by the Director-General was scarcely fair, for, reading the clause, it was intended that the company should have the international traffic. A great amount of correspondence had taken place on this matter, but nothing satisfactory had yet been come to. The competition of the Brazilian Government was not the only one they had to meet. A company was to be formed under the guarantee of the Argentine Federation, which would run from the territory of the Argentine Federation the whole of the way to Europe, a distance of 5,000 miles. Whether that undertaking would succeed or not was a matter for the future. With regard to the future dividend, they were not likely to maintain the dividend for the next half year, because the revenue was extremely unsatisfactory.

Mr. Griffiths considered that the Brazilian Government had broken the contract made with the company, and not only was it a violation of the concession, but was contrary to international law. He suggested that a memorial should be presented to the Government for redressing their wrongs.

The report being adopted, the proceedings closed with a vote of thanks to the chairman.

## West India and Panama Telegraph Company, Limited.

THE twenty-fifth ordinary general meeting of this company was held at Winchester House, Old Broad Street, on Wednesday, Mr. C. W. Earle presiding. The Chairman said: The report was the best in its result that they had ever presented. There had been an increase in the half-year over the corresponding previous period of £672. Working expenses showed a slight increase. There was a decrease of £3,459 in repairing expenses, which satisfactory condition he hoped would continue. With regard to the present position and immediate future of the company, he felt they touched upon delicate ground. There was a great deal which came before the directors in the daily management of affairs of which it would not be expedient to speak about; very often dangers that one saw in the distance might be made certainties by any allusion from the chair. At the same time there had been so much correspondence as to the prospects that for the safety of the concern, especially with regard to subsidies from colonies, it was essential that he should caution the shareholders against too exaggerated views of what the future might be. Their horizon in the West Indies was never entirely clear of clouds. Shareholders must understand that a great deal of revenue depended on subsidies, many of which were annually voted by elective assemblies. They had found that very strange misstatements and garbled accounts were given at those assemblies of what was the then existing condition of the submarine service. He had been told that it was steadily maintained in one assembly that there was only one cable, whereas there had been two for the last ten years. They had also the active opposition of a French company. It was very necessary that an inflated idea should not go forth as to their prosperity, because colonies might think, in face of the prosperity of the company, their subsidy was not required. He concluded by moving the adoption of the report.

Mr. Forbes, in seconding the resolution, expressed his extreme satisfaction at the present position of the company. After the lapse of 20 years submergence of the cables they were in efficient working order. They had succeeded, after many laborious years, in bringing together and retaining a substantial reserve fund.

The Rev. R. Fitzgerald asked the question whether the directors did not see their way to dispense with the services of one of the two ships at present employed; also as to whether the reserve fund, £150,000, with the interest, was not large enough without drawing from the earnings.

The Chairman, in reply, said, with regard to the steamer question, they would be glad to get rid of one of the steamers if possible, but at present this would not be a justifiable course. The reserve fund, in his opinion, taking into account the circumstance, was not by any means a heavy one, and was necessary to keep out other companies.

The resolution was then put to the meeting and carried unanimously.

A vote of thanks to the chairman concluded the proceedings.

## Woodhouse and Rawson United.

THE first ordinary general meeting of shareholders of this company was held on Tuesday at Winchester House, Old Broad Street, E.C., Sir Rawson W. Rawson in the chair.

The secretary (Mr. M. J. R. Dundas) read the notice convening the meeting.

The Chairman: Gentlemen, my first duty to-day is to convey to you the expression of extreme regret of our esteemed chairman, Lord Aberdare, which he has conveyed to us in a note received two days ago, that he was not able to attend this meeting. Some of you may be aware that he had a very serious illness just about the time of the formation of this company, which has confined him for a long time to his house in South Wales, and he is not able to come up to London for the express purpose of this meeting. My colleagues have done me the honour to ask me to fill his place—very inadequately, I fear—on this occasion, but the duty is so simple that perhaps I may not have any difficulty in acquitting myself of it. Our object in meeting you to-day is to comply with the legal formality of holding a statutory meeting within a limited time after the formation of the company. We have not to ask your approval of any propositions to-day, but simply to report to you that all the necessary formalities connected with the constitution of the company, and the amalgamation of the businesses of the several companies which are now united in this one, have been completed. The attention of the board has been necessarily directed mainly to that object, for there was a great complication, as you can well imagine, in amalgamating and combining and organising the business of so many companies, and such a variety of businesses—a manufacturing business, a supply business, a contract business, and foreign businesses. It has been a labour for the directors which they have gladly undertaken, and which I hope they have successfully accomplished. We have also had the material difficulty of removing our whole establishment from the premises occupied by Woodhouse and Rawson, Limited, to those which we have now engaged in a most convenient situation, and I am happy to say, at a very slightly increased expense, close to the Mansion House Station. Our present premises look both into Cannon Street and Queen Victoria Street. They are very capacious, and are peculiarly adapted for a business of this nature—extensive rooms below, extensive rooms above—where we can keep our stock, and, we hope, satisfy all our customers who come to us for supply. The directors have made the shareholders acquainted with the circumstances of the company from the beginning. In our circular of August 2nd we explained the circumstances that had delayed

and hindered the original allotment of the shares. We have since informed our shareholders that a very important and profitable contract which was in negotiation at the time of the formation of the company has been completed, and promises as profitable a result as that which distinguished the last year of the existence of Woodhouse and Rawson, Limited. You are well aware, with regard to the Elmore Company, of that very remarkable discovery which has realised for them so large a profit. We anticipate the same in the matter of zinc. It was one of the matters taken over by us uncompleted. It has since been completed, and it justifies us in assuring you that the prospects held out in the prospectus will be realised. You know that you have the security of the original company for the guaranteed dividend for the first three years; that we have placed in our hands a large amount of capital beyond that realised from our own shares, so that by the end of three years we shall have got into a very large and profitable business. There has been perfect evidence of the wisdom of the original company in extending themselves in this direction. We have by organisation economised very largely the cost of administration. By the possession of increased capital we have received large offers, and important offers of business, which were not likely to be offered to the old company, because they would not have had the capital to carry them out; and if they had been offered they were not in a position to accept them. We may do that now with our existing capital. I think that I may honestly say that the prospects before the company are quite as good as they were held out in the original prospectus, or in the more recent one that has been published on the occasion of our issuing a fresh number of shares. I do not think that I have anything more to say to you. What we had to say, has been said in our addresses to our constituents, but the important point here is, that what we there said has been confirmed by our examination, and by our work during the last four months. In conclusion—for I need not detain you any longer—I would draw a happy omen from the title of our company. We are now not really a "Limited" company, but we are a "United" company. I can say for my colleagues that we are thoroughly united, and I hope they will confirm, if necessary, what I have stated to you to-day; and I sincerely hope that when we meet—as I hope we may, before long—to address you more particularly with regard to the details of the earnings of the company, we shall be able to make such a statement as will ensure not only a united body of directors, but a united body of shareholders, and that we may receive your support and derive all the advantages we hope to gain from it. I shall be glad to the best of my ability to give any information which anybody may require, but otherwise the business of the present meeting is concluded.

Sir John Stokes: I can only say I can fully confirm all that Sir Rawson Rawson has said as to the position and prospects of the business, and that having been engaged in the business of the old company for the last two years, I am perhaps in a good position to say that I think things look better than they have ever done with us.

The proceedings then terminated.

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**Woodhouse and Rawson United, Limited,** have removed from 11, Queen Victoria Street, to No. 88, Queen Victoria Street. Warehouse at 30, Cannon Street.

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### TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ending November 8th, 1889, amounted to £4,636.

The Western and Brazilian Telegraph Company, Limited. The traffic receipts for the week ending November 8th, 1889, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,172.

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## PROCEEDINGS OF SOCIETIES.

### The Institution of Electrical Engineers.

THE first paper of the present Session was announced to be read last night, and is entitled:—

"The Lighting of the Centennial International Exhibition, Melbourne, 1888 and 1889." By K. L. MURRAY, C.E., Telegraph Engineer to the Victorian Railways, Member.

In November, 1887, the Executive Commissioners of the Centennial International Exhibition, which it had been decided to hold in Melbourne in the following year, consulted me as to the practicability, electrically and commercially, of using electricity as a means of lighting the Exhibition; and I felt that I could assure them that the electric light was the only one which could be depended on to efficiently illuminate the buildings and exhibits, and that its cost would not render its use prohibitive.

I recommended dividing the buildings into three sections, and calling for separate tenders for supplying and maintaining the dynamo machines and lamps necessary to light each part; tenderers being requested also to submit an alternative offer for the whole lighting required. My desire was to have each section lighted by a different system, if possible.

Finally, I was entrusted with the duty of drawing up a specification, and tenders were invited.

Those received all named such a high price for the work that I could not recommend the acceptance of any; but being requested by the Exhibition Commissioners to arrange with one or more of the firms which tendered, I was able eventually to do so, and a contract was entered into with the Australasian Electric Light, Power and Storage Company for the lighting of the greater portion of the Exhibition buildings; and an agreement was made with Messrs. Ganz and Co. to supply a transformer plant and light the Armament Court, the official reception and dining rooms, and offices.

The Australasian Company's contract was to supply, fit up, and maintain 825 Brush arc lamps, 37 Brush arc dynamos, 7 Brush Victoria dynamos, compound wound, and 2,000 incandescent lamps, with all requisite switches and fittings. The whole of the machinery and other apparatus was to be of the latest pattern and best workmanship.

As usual in such cases, the buildings were ultimately extended considerably beyond the limits originally laid down. The lighting plant had, of course, to be increased proportionately, so that the apparatus actually supplied by the Australasian Company consisted of, as under:—

40 Brush arc dynamos, known as No. 7 *l*, each capable of giving a current of 10 ampères to from 23 to 25 arc lamps in series.

1 Brush arc dynamo, known as No. 8 *l*, professedly capable of giving current to 55 arc lamps in series.

1 Brush arc dynamo with cast iron armature, known as No. 6, supplying current of 20 ampères for 5 arc lamps.

7 Brush-Victoria dynamos for incandescence lighting, compound wound for 110 volts at terminals.

937 16-hour round type Brush arc lamps, with alabastrine globes; 5 Brockie-Pell 20-ampère arc lamps for lighting the dome; 2 Castle arc lamps.

1,900 Swan lamps of 16 candle-power at 100 volts; 27 "sunbeam" lamps, of sizes ranging from 200 to 600 candle-power each at 100 volts.

All necessary switches, fuses, and leads, the total length of the latter being over 60 miles.

The 7 *l* Brush arc dynamos were of two patterns. First, that in which the bed plate and field magnet yokes are cast in one piece; the field magnet cores, with pole pieces, being, as usual in this form of machine, of cast iron, fastened to the yokes with bolts. The commutator brushes and terminals are mounted on a slab of slate, which is fitted into a recess left for it in the bedplate casting. The other pattern of arc machine has what may be termed a composite bedplate, or no bedplate at all. In these machines the two field magnet yokes are cast in separate pieces, the cores, with pole pieces, being, as in the former pattern of machine, bolted to the yokes. The two horseshoe magnets thus formed are connected by two pieces of railway iron, which constitute whatever of bedplate the machines have. The commutator brushes and terminals are mounted on a slab of wood fitted between the longitudinal pieces of railway iron. The first class of machine will hereinafter be called "solid frame," the latter "rail pattern" machines.

The majority of the solid frame machines had previously been used at the Adelaide Exhibition, but were fitted with new laminated armatures for use in Melbourne. The balance were sent out direct from England. The framework of the 8 *l* dynamo was imported, but the laminated armature was made and all coils were wound in the Australasian Electric Company's workshops, Melbourne. This dynamo was of the solid frame type. The No. 6 dynamo was also of the solid frame type, but had a cast iron armature. Its coils were arranged for a current of 20 ampères.

Two types of laminated armature were supplied with the No. 7 *l* dynamos—one having plates ·05 of an inch in thickness, the plates of the other being only ·022 of an inch thick. The former I will call thick, and the latter thin plate armatures.

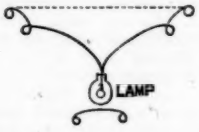
The dynamos for incandescence lighting, seven in number, were of the Brush Victoria pattern known as No. E 2. The nominal output is stated to be 366 64-watt lamps at an average armature speed of 720 revolutions per minute. The machines were of the newest type, and had very massive magnetic circuits throughout. The armatures are wound with only three layers of rectangular wire, each section consisting of three convolutions. The laminated iron core in the V spaces between the windings is not covered with insulation, so that in these parts it is directly exposed to the cooling influence of the air.

The arc lamps were of the well-known Brush 16-hour round type, wound with the low resistance shunt recently adopted by the makers. Alabastrine globes were used.

In the main annexes the arc lamps were arranged in a double row down each bay, one lamp being allowed for about every 1,200 square feet of floor space, The bays were about 50 feet wide, and the distance between the two rows of lamps was about 25 feet, the height of the globe from the floor being about 22 feet.

Incandescent lamps of 16 candle-power at 100 volts, to the number of about 1,900, were used for illuminating the picture galleries, beneath the galleries, in the aquarium, and in the cellars. The concert hall was lighted by 25 "sunbeam" lamps of from 200 to 600 nominal candle-power. The incandescent lamps in the picture galleries were set in a single row, 9 inches apart, on reflecting frames, the reflecting surfaces of which were painted a dead white. These frames were about 18 inches wide, made of sheet metal, with a cross section as shown. Below the lamp another reflector was placed, the primary object of which was to shade the

eye from the direct glare of the lamps and keep the floor comparatively dark. With the above arrangement of reflecting frames the walls were the only portions of the galleries illuminated by the direct light from the lamps, and the total absence of glare allowed of a very pleasant rest for the eyes.




The switchboard for the arc circuits consisted of two parallel rails of wood, on which ordinary double brass binding screw terminals were fixed. The screws on the lower rail were connected to the dynamo terminals, while those on the upper rail formed the terminals of the various lamp circuits. The positive terminals of all machines and circuits were at one end of their respective rails, and the negative terminals at the other. The connection between the dynamo and circuit terminals was effected by means of short lengths of well insulated cable.

The incandescence switchboard was mounted on a well finished cedar stand. It consisted of two large slabs of black enamelled slate, on which the nickelled switches and terminals were fastened. Between the two slabs of slate a suitable recess was formed in the woodwork for the reception of a Cardew voltmeter (Goolden and Trotter's make). In the centre of a cedar panel, below the voltmeter, a small switch was placed, by which any one of the machines could be connected to the voltmeter by turning a handle. Suitable terminals were provided for the introduction of safety fuses, and also for enabling the machines to be coupled in parallel. When so coupled any one or more machines or circuits could be switched on or off without affecting the rest.

The arc circuits mainly consisted of 7/16s stranded cable nigrite and tape insulated, all other being of the same size of cable, but insulated with rubber and braided.

The leads were so arranged that between every two lamps getting current from the main dynamo, there were at least two lamps getting their current from some other dynamos; my object being to make certain that the building should be fairly well lighted, even if several dynamos broke down at the same time. All leads and returns ran in one direction from the dynamo room to the main buildings. But on entering these buildings the leads and returns were taken in totally different directions to the terminal lamps of their respective circuits. By this means, and careful attention to the arrangement of the circuits, the leads and returns never approached each other, except in the dynamo room. Consequently, short-circuiting in the buildings was almost impossible. The lamp circuits were run on the woodwork which carried the roof. The lamps were suspended by cords so that they could be lowered for carboning or other purpose. The wires from the lamp terminals were taken up the suspending cord and lashed to it at a point a few inches from the pulley when the lamp was at its proper height. They were then taken to the woodwork and fastened to it at such a height that the length of wire forming the cord, together with that from the point of lashing to the suspending rope, was at least equal to the height above the floor at which the wires were fastened. This method permitted the lamps to be lowered to the floor, and at the same time left no cable hanging in festoons about the building when the lamps were in their lighting position. From the terminal lamp of each circuit the wires were taken down the wooden pillars which supported the roof, through the floor, and (bracketed to the flooring joists) to the dynamo room.

The incandescence circuits were arranged for a loss of potential of 10 volts. The installation was looked upon as being of a temporary character, consequently the electrical loss was considered to be of less moment than incurring a larger first outlay for heavier leads. Even with the above-named loss the leads for a portion of the distance consisted of two cables, each containing 37/14s; and for the remainder of the distance to the point of distribution one cable of the same size was used. The distribution was effected by means of 7/16s cable, and finally by single wire. All cables were insulated to 150 megohms per mile.

The steam was generated in 12 multitubular boilers, the pressure being maintained at 120 lbs. per square inch.

Three pairs of high-pressure engines were used, having cylinders 20 inches in diameter, with a 40-inch stroke. Normal speed, 80 revolutions per minute; and the total indicated horse-power, with full working load, was about 1,580. These engines were made in Melbourne, and were similar to those used for working the cable street tramways. I may say here that, recognising the very great importance of having the very best driving machinery, I urged the Exhibition Commissioners to send to England for engines specially constructed for electric light work. It was found, however, that time would not permit of this, and an order was given to a firm of local manufacturers who had engines partly made, and could guarantee, therefore, to have them ready in time.

The countershaft was in one continuous line, and measured 202 feet 6 inches over all. It was driven by ropes from the engine flywheels, in the face of each of which 13 grooves were formed for the reception of the ropes. The shaft was in three equal sections, one for each pair of engines. These sections were connected by movable clutches, so that they could run either separately or together as required. To reduce to the lowest degree possible the inconvenience which would result if a pair of engines broke down, the dynamos driven by each section supplied current to lamps distributed over the whole buildings; so that if one-third of the light was taken off, no part of the exhibition would be left in darkness.

The main body of the shaft was 6¼ inches in diameter, but the size was increased to 7¼ inches where the three rope drums were fitted. The normal speed of the countershaft was 190 revolutions per minute.

The dynamos were arranged in a double row on each side of the countershaft; the distances between the centre of the countershaft and spindles of dynamos being 28 feet and 33 feet respectively.

At one end of the countershaft an automatic speed-recorder was placed. This recorder was essentially a chronograph, and consisted of a drum on which a sheet of paper could be fastened; the drum was driven by a tangent screw working in a worm wheel, which latter could be made fast to or released from the drum spindle by means of a friction clutch. The tangent screw was connected by a flexible coupling to the end of the countershaft. A small table was arranged having a motion parallel to the drum axis. On the table an electro-magnet was fixed, the movable armature of which carried a small glass pen. The electro-magnet was put in circuit with a battery and clock having a minute contact. As the drum was mechanically driven (without slip) from the countershaft, its circumferential velocity was proportional to the speed of the shaft; and as the clock marked equal intervals of time on the paper, the distances between these marks gave the number of revolutions of the countershaft when measured on a suitable scale. The dimensions were adjusted so that the drum made one complete revolution in five minutes when the countershaft was running at the normal speed. Hence, if the speed was normal, and without variation, the marks made by the clock would be in a straight line across the paper. If the speed did not vary, but was either greater or less than the normal, the clock marks would still be in straight lines, though making different angles with the edge of the sheet of paper. An irregular speed would show an irregular line.

Geared from the same spindle that drove the reading drum, and mounted on the same base, was a small centrifugal governor. The opening or closing of the balls brought a small contact lever against either one or the other of two contact stops. Two incandescent lamps, one plain, the other coloured red, were hung over the engines, the position of the contact lever determining which, if either, of the lamps should be alight. At the normal speed neither would show light, but a variation of about half per cent. on either side would place one or other of the lamps in circuit. The majority of the diagrams taken by the recorder showed a gradual increase in the speed of the countershaft as the evening advanced. This fact will be referred to later on.

Generally speaking, the lighting throughout the term of the Exhibition was satisfactory. On three or four occasions only did anything occur which would lead the public to suspect that matters were not exactly as they should be. This comparative freedom from inconvenience through irregularities in the lighting was the result of the arrangement of the circuits rather than the constancy of supply to any one circuit.

The boilers, which were designed by a Victorian railway engineer, and built in Melbourne, behaved admirably, though working considerably beyond their proper capacity. The steam pressure was kept extremely regular, the maximum variation seldom exceeding two pounds per square inch for the whole evening's run. The fuel was coke, with a little coal added at times when difficulty was experienced in maintaining the full working pressure required.

Notwithstanding the very regular steam pressure the speed of the engines varied considerably, even though they were fitted with mechanism outwardly resembling Hartnell's automatic expansion gear. With the full load on the countershaft, and the engines indicating about 1,500 horse-power, a single dynamo thrown off or on produced a very sensible alteration in the speed of the rest of the machinery—sufficient, indeed, to necessitate the adjustment of the rheostat controlling the potential difference at the incandescence mains, and to show itself at the speed indicating lamps.

One evening some trials were made to ascertain the effect of an alteration in the steam pressure on the speed of the engines. For this purpose the pressure was altered one or two pounds every half-hour; and it was found that a variation in pressure of one pound per square inch produced an alteration in the speed of the engines of about a revolution per minute, all other conditions remaining the same. The cause of trouble was clearly enough in the governor, and I experienced a great deal of anxiety and annoyance from a fault which should not have existed. The fact is, the makers of the engines could not be made to understand the immense importance in electric lighting of absolute steadiness in the running of the engines, or that there was any difference in the driving of dynamo machines and street tramways.

The Brush Victoria dynamos ran very well through the whole six months the Exhibition was open. In the main they kept cool, though occasionally the thrust bearings showed an inclination to heat. The commutators ran with very little sparking when the brushes were properly adjusted.

Unfortunately the above satisfactory remarks cannot be repeated with reference to the arc dynamos. In the first place, the insulation in many of them was defective or insufficient. Consequently, "electrical fireworks" formed a not unimportant part of the evening's proceedings, till such time as the faulty armatures and field coils had either been rewound or weeded out. In many cases the machines ran for several weeks without giving any indi-

cations of weakness, when suddenly a breakdown in the insulation would take place. Another fault, more serious (if possible) than the last, existed in some of the armatures—namely, those which have been designated "thin-plate armatures." All the laminated armatures supplied, both thick and thin plate, were built up of the so-called H pieces, bound in with a strip of sheet iron, equal in width to the intended thickness of the bobbin core. There was no indication of the H pieces having been passed between rollers, or anything done to give them the same curvature as the armature. The horns of the H pieces were practically flat, hence their resistance to bending was simply that due to the thickness of the metal, which is insufficient in the case of the thin-plate armatures. A few weeks after the opening of the Exhibition several of the thin-plate armatures threw out plates. Two of these plates struck a door-post, and gave unmistakable evidence of the velocity with which they were thrown. On subsequent occasions the plates were not so neatly thrown out, but were caught by the field magnets, and cut the insulation of the armature coils. By the time the Exhibition closed a goodly number of plates had been thrown out. To prevent accidents perforated zinc screens were placed over the armatures.

The cause of these plates breaking off was evidently the continual bending to which they were subjected in passing through the different parts of the magnetic field in which they rotated. The force due to the rotation of the armature tends to bend the plates outwards, while that due to the attraction of the pole-pieces has the opposite tendency (at least with reference to the outer plates). Clearly, then, though the force due to rotation is constant, as the plates pass through a magnetic field which is not uniform in intensity or direction with reference to any given armature radius, the force tending to bend the plates inwards must vary in different parts of the field, and a constant bending of the plates must result. This mechanical fault was a very serious one, and might have caused damage to life and limb.

Before describing the methods used and tests made with the dynamo machines, it may not be out of place to give a few of the reasons which led to the selection of the method adopted.

In order that the tests should be equally satisfactory to all concerned, it was essential that the machines should be tested under the actual working conditions, or while they were at work on their respective circuits. It was not thought to be important that all measurements taken should be of the highest degree of accuracy. As practical engineers know, the conditions of running do not remain constant (especially in arc machines) for many consecutive moments, and the fluctuations which take place affect all data, and the resulting efficiency from instant to instant. Hence the desire was to make tests which would be of practical rather than theoretical value.

The many more recently suggested methods of testing dynamos in which all the measurements taken are electrical, such as Cardew's and Swinburne's, or in which the mechanical is the smaller part, such as Dr. Hopkinson's, were carefully considered with reference to the special form of machine to be tested. Of these methods, that of Captain Cardew seemed to be the only one that would give satisfactory results, for by it the machines can be tested under the actual conditions of working.

Now that it is no longer thought that a dynamo is simply a generator of electricity, and as such may be used indiscriminately for any purpose to which electricity is applied, makers designing special forms of machine to meet the different requirements for which they are to be used, the importance of considering the behaviour of the machine when working under the exact conditions for which it was designed cannot be over-estimated.

In considering the matter, the many advantages, from a mathematical standpoint, of selecting one of the above-mentioned methods, or of running the machine on a closed metallic circuit, could not be overlooked. How much more satisfactory it would be to have the current almost absolutely steady, without those fluctuations caused by a faulty lamp or a bad carbon, which make the readings of the instrument used in testing so irregular, and so difficult to obtain with any degree of accuracy! But the machines were not made to run on closed metallic circuit, and, if they are to be tested fairly, must be tested with all the fluctuations of current, friction caused by pull of belt on bearings, and other modifying influences which exist under the normal condition of working.

In some classes of machine, where the commutator has many segments, and each section of the armature winding has but few convolutions, especially if the machine is intended to light incandescent lamps or charge secondary batteries, the chances of error in any of the above methods would be a minimum. But with machines like the Brush arc dynamos, where the commutator segments are few, and the number of windings per armature coil very great, the errors introduced by running the machine on closed metallic circuit instead of the ordinary lamp circuit for which it was designed may be considerable, unless the metallic circuit is arranged to have the same self-induction as the lamp circuit. With such machines as the Brush the current should be maintained as nearly as possible at the value for which the machine was designed, as small alterations in the current may produce sensible alterations in the behaviour of the machine. The tests should be made when the machines have attained their state of steady temperature. It is, of course, needless to insist that the machine shall on each and every day reach its state of steady temperature, as the atmospheric temperature may vary considerably. It is sufficient if the machine attains a temperature which would be its steady state with some known atmospheric temperature within the range of practical work.

If Dr. Hopkinson's method, where two similar machines have their armatures rigidly connected, were used, it would be needful to consider the exact relative angular position of the corresponding coils in the two armatures. If this were not attended to, the armatures might be so connected that the periodic fluctuations of the current would be either increased or diminished by the combination of the machines; hence the conditions of practical work might not be attained. In any case, with the two machines directly coupled (electrically), as suggested either by Hopkinson or Swinburne, the modifying effect of the self-induction of the circuit on the current fluctuation would be lost.

For these and other reasons the elegant methods adopted by Hopkinson and Swinburne were deemed unsuitable in this particular case. Cardew's method was also rejected as being unwieldy, necessitating as it does the removal of the machines, and so many belt transmissions.

As no other purely electrical method was thought of, it was determined to adopt the method involving the use of a mechanical dynamometer for measuring the energy absorbed by the machine, and to measure the output by the ordinary electrical method.

The chief disadvantage of this plan appeared to be in the necessity of having all the instruments used accurately calibrated. The efficiency would not be the ratio of two sets of measurements taken by the same instrument, or even by two different sets of instruments which could be directly compared *inter se*. But as there is no great difficulty in the calibration of electrical instruments, at least within a degree of accuracy sufficient for all practical purposes, and the mechanical dynamometer can be directly tested, the increased facilities for testing the machines whilst actually working on their respective circuits was considered sufficient to outweigh the disadvantages of the method.

In all efficiency tests but one, Siemens electro-dynamometers were used to measure the current. For some other tests Ayrton and Perry's meters, of both spring and magnet forms, were used. The values of the readings of these instruments were carefully determined by comparison with the electro-dynamometers. The latter instrument was calibrated by connecting it in series with a battery, an adjustable resistance, and a fixed resistance consisting of a large number of small German silver wires arranged so that any number could be put in parallel. The massive terminals to which the small German silver wires were fastened were connected through a very sensitive reflecting galvanometer and a standard Clark cell. A key was, of course, placed in each circuit. With a given number of German silver wires in parallel, the current through the total circuit was adjusted by means of the variable resistance till the potential difference at the terminals of the German silver wires was equal to the electromotive force of the standard cell. The exact resistance of the German silver wires was immediately measured by the aid of one of Elliot's metre bridges. A small standard resistance was constructed from a piece of the same German silver wire, as that used in the fixed resistance. The exact value of this coil was found by comparison with one of Elliot's standard B.A. units. All apparatus to be used was placed in position some time before required, to allow the temperature of all parts to become equal. The temperature was taken by a standard thermometer which had been tested at the Kew Observatory. Two stardard cells were used—one by L. Clark, Muirhead & Co., the other made up at the time in accordance with Lord Rayleigh's instructions, whose formula for the variation of the electromotive force of the cell with change of temperature was used. The two cells when tested were found to be almost exactly equal. No difference could be detected when they were compared by the condenser and ballistic galvanometer. But a very small difference did exist, and was shown by the deflection on a sensitive reflecting galvanometer when the cells were connected zinc to zinc, the remaining terminals being connected to the galvanometer.

In all calibrations some measurements were taken with each of the standard cells.

The results of the calibration tests of the Siemens electro-dynamometer gave the value of the constant = ·8716. The constant as given by the maker was ·87—a difference of less than one-fifth per cent. The same electro-dynamometer when compared with one of Ayrton and Perry's latest spring ammeters differed by very little more than ·01 per cent.

Two voltmeters were used—one of Ayrton and Perry's spring form, the other of the electro-dynamometer pattern. Both of these instruments were wound with copper wire, and large resistance coils of German silver wire, differentially wound, were used to reduce the potential difference at the terminals of the instrument proper. The voltmeters were calibrated in exactly the same manner as the current-meters. They were also checked by measuring the potential difference at the terminals of a known resistance by means of the condenser and ballistic galvanometer. These two methods gave exactly the same results in several tests, and the condenser method was ultimately discontinued, owing to the difficulty of obtaining a place where the ballistic galvanometer could be used without interference from locomotives moving in the vicinity. The dynamometer voltmeter was afterwards compared with one of Ayrton and Perry's spring meters: for 100 volts the difference in their readings did not exceed one-tenth of a volt.

The metre bridge was calibrated by Carey Foster's well-known method. An additional correction had to be made for the heating of the gauge wire by conduction from the binding screws. No special means were previously employed to prevent error from this source, as it was not anticipated that the effect would be appreciable.

*(To be continued.)*

## THE EDINBURGH ELECTRICAL EXHIBITION.

IMPORTANT CONCESSIONS TO THE TRADE.

ON Monday last an adjourned meeting of the Electrical Trades Section of the London Chamber of Commerce was held at Botolph House, Cheapside, under the presidency of Mr. R. E. CROMPTON, for the purpose of receiving the report of the special committee appointed to consider the conditions on which it might be advisable to take part in the proposed Electrical Exhibition to be held in Edinburgh next year. There were also present Sir James Anderson, Major Flood Page, Mr. Swinburne, Prof. G. Forbes, Mr. G. Binswanger, Mr. Musgrave Heaphy, Mr. C. J. Wharton, Mr. J. F. Albright, Mr. R. S. Erskine, Mr. A. P. Trotter (the sectional correspondent), Mr. W. Beaumont, Mr. A. P. Lundberg, and Mr. Stepney Rawson.

Mr. TROTTER read the report of the special committee, which, after quoting the resolution passed on October 28th, proceeded as follows:—

"Your committee have considered the question referred to them in the above resolution, and have the honour to report as follows:—

"1. If the Exhibition Committee in Edinburgh had consulted the electrical trade as to the desirability of holding an electrical exhibition in the year 1890, they would probably have received a well-nigh unanimous answer that it was too soon after the Paris Exhibition to serve any useful trade purpose.

"2. The opinion of the industry on such a matter can easily be ascertained now that an Electrical Section of the London Chamber of Commerce has been formed, as members from all parts of the kingdom belong to that section.

"3. Nevertheless, the Exhibition being in course of organisation, it seems advisable that the trade should not refrain from exhibiting, provided that terms can be obtained from the exhibition authorities more favourable to the trade than those provided in the regulations which have been issued.

"4. It must be clearly understood that this report is not dealing with the question of lighting the Exhibition, for which, of course, the Exhibition authorities must pay in the usual manner, nor with any question involving the purchase or hire of any electrical plant which the exhibition authorities may require for their own purposes, and but simply with the question of exhibitors.

"5. The charge for space is to be 2s. 6d. per square foot, the minimum charge being £2 10s.

"We think that the electrical exhibitors should be allowed an agreed-upon space free, and should pay for any additional space they may require.

"6. Many of the electrical exhibits, though not intended in any way to light the Exhibition, cannot be properly shown unless they have steam or current supplied. We think that when steam power or current is necessary for the proper display of the exhibit, they should be provided by the Exhibition authorities, free of cost, to the exhibitors.

"7. The regulations provide that the exhibitors should furnish all necessary attendants. We recommend that for electrical exhibits, where there is no machinery in motion, the electrical section should club together and appoint and pay for such attendants as they may judge necessary.

"8. We think that the Exhibition authorities ought to pay for the insurance of the electrical exhibits.

"9. We suggest that there should not be any awards, but if it is determined to have awards, we think that the Council of the Institution of Electrical Engineers, and the Electrical Section of the London Chamber of Commerce, should recommend the jurymen to the Exhibition authorities.

"10. Clause 25 of the regulations is as follows:—'The Executive Council reserve to themselves the right of examining, testing, or analysing any of the exhibits.' We do not think that any person whatever, except the electrical jury, should have the right to test, analyse, or examine (in the sense here meant), any of the electrical exhibits, and we think that any electrical exhibit may be sent without being in competition, and such exhibits should not be tested or analysed, even by the jury.

"11. In conclusion, although the whole of the electrical trade is now busier than it has ever been, and is certain to be busy all through the year 1890, and much valuable time will be occupied in the preparation for the Edinburgh Exhibition, and although it is not likely that any profit or advantage will accrue to the electrical exhibitors, yet, on the whole, as the Queen has given her support to the Exhibition, and Scotland generally seems inclined to do what can be done to make the Exhibition a success, we think that the electrical trade should not 'boycott' the Exhibition, but we strongly urge that the permanent committee of the section should obtain terms at least as favourable as those indicated above.

"12. Your committee have good reason to believe that well nigh the entire trade will support such improved and reasonable conditions as we have suggested.

"Signed on behalf of the committee,

"ALEX. P. TROTTER, *Correspondent.*"

The CHAIRMAN invited expressions of opinion from anyone present as to the various matters in the report, and in reply to a question whether any communication had been received from the Exhibition authorities, stated that so far as he was aware the only communication the committee had had had been with members of the trade. There were present two gentlemen as a deputation from the Exhibition authorities. Those gentlemen were Mr. Lee Bapty (the general manager) and Mr. Gashell Exton.

Mr. SWINBURNE said that one of the gentlemen had stated that the authorities were willing to meet the electrical trade, and that the charge for space might be foregone if the Exhibition was financially successful. And they were prepared to pay for the whole of the electric lighting if done by tender.

Mr. TROTTER, in answer to a member, stated that the views of the special committee met with the support of representatives of the trade.

Major FLOOD PAGE added that the committee appointed specially to draw up a report had no power to enter into communication with the Exhibition authorities. That duty would come upon the permanent committee. If the section adopted the report, then they would take up the negotiations. An expression of opinion that day of the section would have great weight, particularly as it appeared that the Council of the Exhibition were prepared to meet the trade halfway.

The CHAIRMAN: If we only get the concessions Mr. Swinburne has mentioned we shall have done something for the trade.

Mr. MUSGRAVE HEAPHY: One of the paragraphs in the report says the Exhibition authorities ought to pay for the insurance.

The CHAIRMAN: Yes, we were mulcted very heavily at Kensington, simply because of the inferior construction of the buildings in which our machinery was put. We had to pay an enormous sum for insurance, which was a great hardship, and we think that should not happen again.

Prof. FORBES drew attention to the question of testing. The trade did not want to have machines tested which had been at other Exhibitions, but there was a large quantity of machinery, especially the alternating current machinery, which required testing; and the trade would find it an enormous advantage if the Edinburgh people made reliable tests of the alternating current machinery.

Mr. SWINBURNE asked what had been the results of the testing at other exhibitions?

Prof. FORBES replied that tests of the greatest importance had been made at Philadelphia, Munich, and at the Crystal Palace. The result was that no more tests of direct current dynamos were required; but it was very necessary that there should be reliable tests of alternating current dynamos and transformers. At the present moment such tests would be of the greatest value.

Major FLOOD PAGE: It depends upon who are going to make the tests.

Prof. FORBES: Undoubtedly.

Major FLOOD PAGE pointed out the recommendation in the report as to the appointment of a joint jury, and added that the tests at the Crystal Palace went on for three months and entailed great expense. He then proposed the following resolution:—"That the report of the special committee on the Edinburgh Electrical Exhibition be received and adopted, and that the subject be now referred to the permanent committee of the section with power to negotiate and carry out the necessary arrangements with the committee of the Edinburgh Electrical Exhibition."

Mr. LE NEVE FOSTER seconded the motion, which was carried unanimously.

Mr. ALBRIGHT thought something more definite as to space for electrical exhibits should be submitted to the authorities than that which appeared in the report.

Major FLOOD PAGE was of opinion that it would be of immense advantage if the whole of the electrical exhibitors would exhibit through the Electrical Trade Section of the Chamber. One of the rules of the Exhibition Council was "Applications for space from foreign countries and the Colonies, for which no commissioner is nominated, must appoint representatives in Scotland." But if a commissioner was nominated, all the entries would go through him. In that way—as at the Paris Exhibition—they would be able to get a more united action. If the whole of the electrical exhibits were sent through that section of the Chamber, a great good would be effected. Then the section would know approximately the amount of space required, and be able to approach the Council and ask for something definite.

Sir JAMES ANDERSON, in answer to the Chairman, said that the cable company he represented would do all they could to assist the object of the meeting. He was over in Paris the other day, and such was the arrangement at the Exhibition, that he could not find their exhibits, although they had received a gold medal for them. (Laughter.) The Edinburgh Exhibition came very suddenly upon them, but his company would do what they could.

The CHAIRMAN: What do you think of our treating Scotland as a "foreign" country—(laughter)—and all of us going under one section.

Sir JAMES ANDERSON: I think Scotland would not object to our going under one section.

Mr. RAWSON: The idea is not quite one of treating Scotland as a foreign country, as you jokingly said, but of the electrical section as against the other sections. It is not entirely an electrical exhibition, because there are other departments, and it is a question of organising our section.

The CHAIRMAN: How would it be for the section to have so many hundred square feet space allotted us free, and arrange the division of it ourselves?

Mr. FOSTER: That is the way it was done at Paris.

Mr. ALBRIGHT moved, Mr. SWINBURNE seconded, and it was resolved:—"That provided the Edinburgh Exhibition authorities accept the terms as set forth in the committee's report, the Electrical Section of the London Chamber of Commerce act generally

as commissioners for the electrical trades for the Edinburgh Exhibition."

Mr. Lee Bapty and Mr. Exton were then ushered into the room, and were addressed by

The CHAIRMAN, who, in general terms, stated the result of the deliberations of the meeting, and drew attention to their requirements as to space, insurance, awards, supply of steam power and current, lighting, &c., as given in the committee's report.

Mr. LEE BAPTY said he had hoped to have had an opportunity of meeting the sub-committee to discuss the report before it was issued to the section, because he had already consulted his council in Edinburgh, and they were prepared with a certain amount of concessions which he trusted would have met their views. For instance, he noticed in the report of the previous meeting that they seemed to think they were to be asked to light the Exhibition for nothing, and that the council had taken action without consulting the trade in any way. He had only been appointed manager of the Exhibition after the whole thing was decided upon, but he had been informed that the project was broached to the electrical and technical papers before it was put into a concrete form, and that it met with their support. Consequently the promoters of the scheme in Edinburgh considered that they would also have the support of the members of the trade. Objection appeared to have been taken at the last meeting that it was not fair to ask the electrical trades to come down to Edinburgh to make money for the promoters of an exhibition there. But that was the very last thing that the promoters of the Exhibition had in view. All they wanted was to present to the visitors to the Exhibition the latest developments of electrical science and industries, and as a proof of that, he had authority to offer to all exhibitors of electrical appliances or apparatus of any kind whatever who came there with the *cachet* of the section, that after the legal demands, any money paid for space by those exhibitors should be returned in full, or as near as the surplus would allow. He hoped that would meet their views in the matter of having free space, because he believed it was certain that there would be a surplus. With regard to the payment of insurance, that was a matter which had not cropped up at all; but he should be glad to ask his committee to meet them on that point. It was not a very serious matter.

The CHAIRMAN: The cause of this action is that when the exhibitions in London were lighted the buildings were of such a nature that the insurance was put very high, and it came heavy upon the exhibitors.

Mr. BAPTY: In Manchester we only paid 7s. 6d. per cent., and we had about two and a half millions' worth of pictures there. Ten shillings covered all risks—damages and everything.

The CHAIRMAN: If that is so, and you have good buildings, of course it will not be so hard?

Mr. HEAPHY: It will all depend upon how the Exhibition is built.

Mr. BAPTY replied that he could not say exactly how it was to be built, but at Manchester the premiums were reduced very largely by their undertaking to provide efficient watching, and he had there 24 watchmen and 6 firemen constantly on duty throughout the whole night, and there was not a single claim during the whole time. With regard to the awards he thought he might say they would leave themselves entirely in the hands of the section. The subject was broached at a meeting on Monday or Tuesday last, and there appeared to be a feeling that it would be desirable to have certain trials if the exhibitors wished to have them, but that would be a matter in which he would say they should not be prepared to have trials at the request of the exhibitors except at their expense. If the exhibitors in a certain section wished to have trials and to have a competent test by a jury he thought they ought to be asked to pay for that jury. The testing was not intended to apply to machinery or electrical appliances, but was simply to enable the authorities to reject any intended exhibit which might be dangerous. For instance, somebody might wish to exhibit some oil which might not be considered safe, and the authorities wanted to have control over them. So far as the Electrical Trades Section was concerned, he would give the most unqualified undertaking that the rule would not be put in force. As to the lighting, there had been no intention on the part of the Executive Committee that the lighting was to be free. They were now preparing the specifications for the electric lighting contracts, and they would be sent out in the usual course to all electric lighting firms. The only exception to that course would be where someone had a new system of lighting, or a new lamp or something, and desired to show it, and if he wanted to light a refreshment room or office apart from the rest, he supposed there would be no objection to its being done for nothing. With respect to the steam power, that would be provided for the ordinary exhibits. Of course, in the exhibition of electric lighting, it would form a separate item. There ought to be no difficulty in finding free current for exhibitors who wished to show motors, &c. If the support of the Electrical Trades Section were obtained, there would be no effort wanting on the part of the Council of the Exhibition to make it a very great success. His Committee felt that the advance which had taken place in electrical science, and the improvements during the last few years since the previous exhibition in Edinburgh, had been sufficient to warrant another exhibition being held.

The CHAIRMAN remarked that he thought it would have been a very wise thing if the Exhibition authorities had communicated with the section, in order to learn the views of the trade. It would be better, now, to give Mr. Bapty a report so that he might deal with it item by item, and state what his committee were prepared to concede, and what they were not, so that they might have a definite statement as to the question of space and other matters.

Mr. BAPTY: How do you propose to deal with anybody outside your section who wished to exhibit electrical appliances?

The CHAIRMAN: I think they should pay for the space.

Major FLOOD PAGE thought they might well be encouraged from what had fallen from Mr. Lee Bapty, and it also showed them that the action taken by the section was a proper one. Although the time of the Exhibition was not a particularly fortunate one, they would do all they could to make it a success. They were now in the middle of November, and entries would close on the 30th of the month. He would like to know if that date could be extended, and if they could be allowed to enter up to the end of the year.

Mr. LEE BAPTY said he would make a note of that and submit it to his council.

The CHAIRMAN desired further to state that he could not take Mr. Bapty's answer as to testing as final, for there was a very strong feeling with regard to some kind of electrical apparatus which would add enormously to the interests of the Exhibition, such as alternating current machinery and transformers, which would only cost a moderate amount of money to test, and a good deal of that machinery would be sent to the Exhibition. The other kind of machinery had been tested, but it would be found to be a great advantage to the public and everybody concerned if reliable tests were made of electrical current machinery and transformers.

Prof. FORBES added that considerable power would be required —something like 200 horse-power—to make those tests.

Mr. BAPTY thought it would be very easy to divert the power for a specified period to one special machine to secure the tests which were required.

Prof. FORBES wished Mr. Bapty to be fully sensible that such a test would entail considerable expense and some time to carry out properly.

Mr. BAPTY: Is it only desired to supply this in the case of exhibitors who voluntarily submit themselves to the ordeal?

Prof. FORBES: At the Institute of Electrical Engineers it was thought that the best plan would be to have a test made by competent judges, assisted by the exhibitors. I think it is understood that exhibitors should be allowed to decline the test if they choose. Then there was the question of meters, which had never been fully tested, and new ones were coming out every week.

Mr. LEE BAPTY then thanked the meeting on behalf of the Executive Council in Edinburgh, and again added that nothing would be wanting on their part to make the Exhibition a success from an electrical point of view, especially as they were bound to make that section go in order to keep their promises to the public.

The proceedings then terminated.

## ELECTRIC LIGHTING AND THE COUNTY COUNCIL.

### THE METROPOLITAN COMPANY'S WORKS.

AT the meeting of the London County Council on Tuesday last (the Earl ROSEBERY in the chair), Mr. A. H. HAGGIS, the chairman of the Highways Committee, presented a report stating that they had considered a number of notices given to the Council under Electric Lighting Orders. The first was as follows:—

"16th October, 1889, from the Metropolitan Electric Supply Company, Limited, of its intention to lay mains and distributing boxes in Oxford Street (part of), Wardour Street, Princes Street, Gerrard Street, Macclesfield Street, and Drury Lane (part of), and also to place mains in the subways in Shaftesbury Avenue and Charing Cross Road, as shown upon four plans submitted."

With reference to this notice, the committee reported as under:—

"The works referred to in the Metropolitan Company's notice as proposed to be carried out in the streets therein specified, are similar to those of the same company which were sanctioned by the Council on the 1st ultimo; and your committee recommend—

"(1.) That the Council do approve of so much of the works referred to in the notice, dated 16th October, 1889, of the Metropolitan Electric Supply Company, as are proposed to be carried out in Oxford Street (part of), Wardour Street, Princes Street, Gerrard Street, Macclesfield Street, and Drury Lane (part of), on condition that the mains be laid, wherever practicable, under the footways.

"With reference to the laying of the mains in the subways referred to in the notice, your committee may state that they are preparing a code of regulations, which they will shortly submit to the Council for approval, with respect to the use by companies and others of the subways vested in the Council; and in these circumstances your committee recommend—

"(2.) That the Council do sanction the laying of the Metropolitan Electric Supply Company's mains in the subways in Shaftesbury Avenue and Charing Cross Road, in accordance with the notice, dated 16th October, 1889, and the plans submitted therewith upon the following conditions:—that the mains be laid in iron pipes as shown by alternative No. 3 on the tracing submitted by the company; that the positions to be occupied by the mains in the subways be subject to the approval of the engineer of the Council, and that the work of placing the mains be carried out to his satisfaction; and further, that the company,

before commencing to place its mains in the subways, do give an undertaking under seal, to be prepared by the solicitor, to pay such an annual amount for rent as may be settled by agreement, or, in the case of difference, by arbitration.

"It will also be necessary, in order to comply with section 20 of the provisional order, for the Council to serve a separate notice requiring the company to lay its mains in these subways; and your committee recommend—

"(3.) That the Clerk be instructed to forward to the Metropolitan Electric Supply Company, Limited, a notice requiring the company to lay the mains in Shaftesbury Avenue and Charing Cross Road, referred to in the notice dated 16th October, 1889, in the subways in those thoroughfares."

The recommendations of the Highways Committee were approved without discussion.

KENSINGTON AND KNIGHTSBRIDGE WORKS.

A second notice was dated 23rd October, 1889, from the Kensington and Knightsbridge Electric Lighting Company, of its intention to extend its mains in Gloucester Road and Ennismore Gardens.

The committee reported that there appeared to be no objection to the works and recommended, "That the Council do signify its approval of the works referred to in the notice, dated 23rd October, 1889, of the Kensington and Knightsbridge Electric Lighting Company, Limited, of its intention to lay mains in Gloucester Road and Ennismore Gardens, as shown upon two plans submitted with the notice, such approval being subject to the same conditions as were imposed in respect of the company's works previously sanctioned by the Council."

The same committee further reported that they had considered a letter, dated 24th October, 1889, from the Kensington and Knightsbridge Electric Lighting Company, forwarding, at the request of the vestry of Kensington, a plan of a 24-inch culvert to be used for the purpose of carrying mains across the carriageways, in place of the culvert shown upon the plans previously deposited by the company, and approved by the Council. The company asked for the approval of the Council to the proposed alteration in the manner of constructing the culvert; and as the committee saw no objection to the proposed alteration, and as, moreover, the culvert now proposed would be slightly narrower than that previously sanctioned, they recommended, "That the sanction of the Council be given to the plan submitted with the letter, dated 24th October, 1889, of the Kensington and Knightsbridge Electric Lighting Company, of a culvert to be used for the purpose of carrying mains across the carriageways (in place of that already sanctioned by the Council), such sanction being subject to the condition that there shall be not less than 9 inches of Portland cement concrete between the top of the covering stones of the culvert and the underside of the paving."

FIRE BRIGADE ELECTRIC BELLS.

Colonel HOWARD VINCENT, as Chairman of the Fire Brigade Committee, reported that, in accordance with the Council's instructions, the solicitor had prepared a contract with Mr. J. Sax for the repair and maintenance for twelve months for £157 of the whole of the electric bells belonging to the brigade. The finance committee having approved the estimate the Fire Brigade recommended and the Council agreed to fix its seal to the contract.

## ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1888.

11927. "Machine for covering electrical conductors." S. PITT. (Communicated from abroad by J. B. Atherton, of New York.) Dated July 26. 8d. The special object is to provide a machine for winding strips of paper or similar material spirally upon electrical conductors to produce an insulated conductor. 12 claims.

13622. "Improvements relating to meters for the measurement of alternating currents of electricity." S. Z. DE FERRANTI. Dated September 20. 8d. Claims:—1. The employment of a compound wound converter for feeding electrical meters used for measuring alternating currents, substantially as described. 2. The combination with an alternating current recording meter of a converter having primary and secondary coils, viz., one primary so connected that the current to be measured passes through it; another primary connected with points maintained at an approximately uniform difference of potential and a secondary in the circuit of which a meter is included so that the meter receives the induced current resulting from the influence of the two primary coils upon the converter. 3. The combination with the leads of an alternate current dynamo, of the converter core, primary coil forming part of the lead, secondary coil and recording meter in the secondary circuit, and the coil cross connected between the leads.

16257. "Improvements in arc lamps." C. E. L. BROWN. Dated November 9. 8d. Claims:—1. In an arc lamp the combination of a solenoid or regulating coil having a large self-inductive action, an iron core adapted to move in two directions and one or more soft iron wheels or masses upon which the said core is held by magnetic attraction, the arrangement being such that the said wheel or wheels or mass or masses will automatically control the position of one of the carbon rods or holders. 2. In an arc lamp such as referred to in the preceding claim, providing the iron core with a wedge shaped plate of non-magnetic material, such as brass, interposed between the core and the iron wheel or mass (or wheels or masses). 3. The improved arc lamp as described with reference to the drawings.

16625. "Improvements in electric arc lamps." E. W. ANDERSON. Dated November 15. 8d. Consists of a peculiar form of levers and clutch for controlling the carbons and giving the necessary motions for striking the arc when starting, for feeding the carbon or carbons together as they are used up, and for permitting them to come together ready for starting again whenever the current is cut off or interrupted from any cause. 3 claims.

13805. "Improvements in the application of electricity to vehicles on tram and railways, and in the apparatus for effecting the same." F. WYNNE. Dated September 25. 11d. Relates partly to improvements in arrangements for series working, and consists in the insertion of short independent insulated joint pieces in the length of the main conductor at the ends of the overlapping lengths. 13 claims.

## CORRESPONDENCE.

### Teachers and Students.—Prof. Perry's Address to the Members of the Junior Engineering Society.

I should be misunderstood were I to pass unnoticed the letter of Prof. Perry, which appears in your issue of November 1st.

Prof. Perry should be aware that the explanation he now gives for having attributed to Thomson's partner what he (Perry) described as one of the grandest discoveries of the century is no excuse whatever.

At the time the address was being drawn up Mr. Perry was well aware that the discovery he alluded to, viz., the dynamo principle, was made by myself, who never was a partner of Thomson.

The excuse now put forward simply amounts to this, that Mr. Perry was in a hurry when he wrote what he must have well known was not true.

Inaugural addresses are prepared usually with care, and any one who reads Mr. Perry's address will, I think, come to the conclusion that care and thought were bestowed on its preparation. Throughout the whole of it there appears to have been a well arranged scheme, and the impression Prof. Perry would seem to me to have desired the students to carry away, was that Sir William Thomson was the Alpha of electrical engineering, the one who sowed the seed and the one who created and reared the only electrical schools deserving consideration. I think also one may read between the lines that Mr. Perry would like it to be thought that he and his partner are the outcomes of Thomson's teachings, destined to be the inheritors of Thomson's mantle.

Prof. Perry begins his address by putting his audience in a good humour; he treats the subject somewhat playfully, telling them that up to 1870 the information which was given in electrical works was altogether of such a "childish order as to be useful to practical jokers." He says "that in the year 1870 the writers and nearly all the teachers in schools and colleges remained in a state of ignorance of everything except what may be called electrical tricks."

A little further on it is stated the researches of Cavendish and Faraday and Joule were known to a few, and Thomson's name follows.

The advent of Thomson is delicately veiled with a certain amount of mystery by stating "that Thomson's papers had been buried, some of them more than 20 years." It seems to me that at this stage it was probably considered that it would add lustre to the hero from whom Prof. Perry receives a reflected glory if his name could anyhow be associated with the grandest discovery of the century. It would have been too risky to have suggested the discovery lay hidden in the buried papers and only wanted digging out, but a Varley was the discoverer, and a Varley was a partner of Thomson; hence the statement that the discovery was made by Thomson's partner. Of course, I do not wish

it to be considered that this is the true explanation. It is only put forward as a possible hypothesis.

Anyone reading Perry's address might be led to suppose the partnership between Varley and Thomson was a scientific one. It was not so; it was simply a commercial partnership made with a view to reaping a profit from their separate patents, and, regarded from a pecuniary point of view, the partnership must have been a very profitable one—more profitable, I should imagine, than even the establishment of the technical schools in connection with the City Guilds has been to the endowed Professors who preside over them.

I consider Prof. Perry carries boldness to the verge of rashness in his address; and further, I contend he indulges in the scientific uses of the imagination to an unduly large degree when he says that electrical science in the year of grace, 1870, had not passed beyond the stage of "electrical tricks."

I think I may be possibly able to explain how it is that, according to Perry, the emancipation from a state of darkness to a condition of light commenced at the date he has named.

I happen to possess copies of correspondence between Thomson and myself embracing the period 1865 to 1872, and a reference to it enables me to say, with some degree of confidence, that the year 1870 was coincident with the advent of a constellation in the scientific heavens; two stars of this constellation must have been in the immediate vicinity of the horizon in 1870, if, indeed, they were not a little above it. At the present time these stars are fairly high up in the heavens and well in sight, and a third star belonging to the same constellation has also risen above the horizon.

On the principle that it is seldom sufficient to act simply on the defensive I propose to interpolate a little historical matter, and I propose to go back so far into the benighted period as 1854, viz., 16 years before the days of electrical tricks began, according to Perry, to be numbered.

At the period (1854) the practical jokers had managed somehow to weave a network of telegraphs over the whole of the United Kingdom, and also over the greater part, by far, of Europe. Ireland was united both to England and Scotland by submarine cables, and England was connected to the Continental telegraph systems through France, Belgium, and Holland. A cable, 340 miles in length, was also laid in 1854 for war purposes between Varna and the Crimea, and I was appointed to the charge of the first field telegraphs used in war in the spring of 1855.

In the year 1854 engineers were already discussing the project of bridging electrically the Atlantic Ocean.

In 1854, or 1855, the Varley unit and resistance coils were introduced by my late brother, who inaugurated the era of *exact* electrical measurements. I quote from a letter of Sir William Thomson, where he says:—

"I well remember when I first made his acquaintance at Valentia in the autumn of 1858, when he was sent by my brother directors to co-operate with me in examining into the cause of the failure of the cable after its short-lived success. I had been extemporising resistance coils to measure the insulation resistance of the cable. He came with a box of resistance coils ready made—a thing not then generally known—quite unknown, I might almost say, among English practical electricians."

Of course Thomson was speaking of what was within his own knowledge only, for resistance coils were necessarily known to the engineers of the Electric and International Telegraph Company, seeing that in 1855 they were in practical use in the service of that company.

I wish to guard against claiming for my late brother more than is fairly his due, and, therefore, I desire to say the introduction of the Varley unit of resistance, which came into very general use in this country, and also in America, was simply an engineering incident so far as my brother was concerned, and that it does not trench in any way upon that great creative and far reaching work which will always be associated with the name of Joule.

I would now refer to the early spring of 1858, some few months before the first Atlantic expedition started. At the time I have mentioned upwards of £10,000 had been already spent in electrical experiments by the scientific advisers of the Atlantic Telegraph Company. The results obtained, as well as the details of the experiments, were, of course, well known to Thomson, and they were acquiesced in by him, and most, I might say nearly all our physicists, including Cromwell Varley and Faraday. The conclusions that had been arrived at, were, that small conductors would transmit signals more rapidly than conductors of larger section.

In the published proceedings of the Institution of Civil Engineers of 1857 will be found Faraday's explanation of this startling discovery, which was, of course, a most satisfactory one to the projectors of the Atlantic cable, and was consequently duly trumpeted.

I was away in the East during the greater portion of the time the Atlantic electrical controversy was occurring, and when I returned in the early winter of 1856, I was simply astonished, and set myself the task of trying to discover the source of error that I felt sure was lurking somewhere. At about 12 months later I had not only detected how the blunder had been made, but I was able to make it clear to civil engineers who did not profess a knowledge of electricity.

I drew up a paper, which I submitted to the Institution of Civil Engineers in February, 1858, at the time submarine telegraph papers were being discussed, and I was invited to take part in the discussion, which I did, laying bare the mare's nest, and bursting up the expensive bubble.

At the hands of our great engineers, Robert Stephenson, Locke (the then President), and others, I received something of the nature of an ovation. Mr. Locke was good enough to say my contribution was more to the point, and worth more than all the rest of the discussion put together. Prof. Graham, the chemist, and the Master of the Mint, congratulated me most warmly, and Faraday, notwithstanding I had opposed the views he had publicly expressed, wrote me a letter some months later of a most complimentary and flattering character. In this letter he endorsed my views, and added that I was well able to hold my own, and he further added that I did not need any assistance from him. Faraday was made of a different kind of clay to *some* of our modern mathematical physicists. My paper was accepted, but owing to the large number of evenings which had been already devoted to discussing submarine telegraphy, it was read only in abstract. An opportunity was, nevertheless, offered to the scientists to express their views, and they were invited to do so. To my disappointment not one of them responded to the invitation; the only one who broke a lance with me was Cyrus Field, and he referred to me in his speech, sneeringly, as a *young man* who had been applauded, but who had gone directly in the face of Faraday. Now, where was Thomson all this time? Silent, like the rest. He must admit that the above paper of mine, and also the one I read the following year at the Society of Arts, were both of them valuable contributions to submarine telegraphy; but neither in private nor in public, when detailing the history of this period, has he ever once referred to my work.

I was the first to show that sheets of paper could be made to insulate, so as to be available for the construction of condensers. I originated the idea of constructing artificial submarine circuits, and in my second paper I suggested their use as a means of solving by direct experiment the problems connected with submarine telegraphy; I also described in detail one I was then constructing.

The paper condensers of mine have proved very useful to Thomson; and Thomson is, of course, aware that artificial submarine circuits, as described by me in 1859, have since enabled the longest submarine cables to be duplexed.

My second paper was fairly discussed, but not seriously opposed; Siemens spoke but simply to cover a retreat, and Tyndall made some remarks which I feel sure he would not have made had he only have known

I had the letter Faraday had written me. I have sometimes regretted I never made any use of so valuable a testimonial, and I confess I was tempted to do so by what Tyndall had said in the discussion. A sense of delicacy, however, prevented me. I felt at the time it was so good of Faraday to have written me a letter which acknowledged he had been misled, that I considered the only thing which would justify my making use of it would be some one asserting Faraday and I were electrically opposed. Perhaps I may be allowed to say here Faraday had been *simply* misled, the explanation given by him at the Institution of Civil Engineers, to which I have previously referred, was a perfectly correct one, but the conditions under which the experiments had been tried were not the conditions which prevailed in working circuits, and hence the mistake which was made.

All that has been related immediately above occurred in the Perry days of darkness. I think the period before 1870 would be more truly described as an era of serious and enthusiastic work.

In 1846 the first electric telegraph company was incorporated. In the space of eight years only, which brings us up to 1854, telegraphs were in active work all over Europe. The engineers of that period have no reason to hide their heads; more real work was done in those few years than can, I believe, be fairly credited to the mathematical physicist during the whole of the 35 years which have elapsed since 1854.

What the mathematician has been doing for the most part has been simply examining and microscopically measuring, with mathematical spectacles, the edifices raised by the engineers of the earlier period, the nearest approach to anything original they can be credited with, is simply the designing measuring instruments, and in such work our mathematical men are much more indebted to the intelligent mechanic than they are disposed to admit. What Edison has lately said I believe will be found to be *absolutely* true, viz., "That our savants are a great success at explaining in learned language what other men have done, but that all their formulated knowledge has never given the world more than two or three inventions of any value."

For my part, I sometimes think there were some of us in the so-called days of darkness who had a greater knowledge of electricity than all the Perry school put together. We were not learned, truly, and never pretended to be. We had not contracted the range of our mental energy by storing up and exhausting our minds over reading up mere scientific literature. We were neither talkers nor boasters, nor were the compilers either of the past or the present electrical literature; but we loved work, and we could think and construct, and the knowledge we possessed was of that description that it enabled us to some extent to think in the language of electrical science.

In the earlier days of railways and telegraphs, not only had altogether new edifices to be erected, but the material out of which they have been constructed had to be searched for and discovered.

After the world had been fairly covered with railways and telegraphs, the time arrived when it became important to make the most of one's material, and the measuring epoch began; but you must first catch your hare before you cook it, cooking hares is a simpler process than catching them, and those who have not the genius for catching hares should be content with whatever credit they can fairly claim for skill in culinary operations; but there is a *clique* of mathematical cooks who have axes of their own to grind; a *clique* who write the electrical books, and who are very active in the Society of Electrical Engineers and other scientific societies, and these men are not satisfied simply to perform the functions Nature has qualified them for doing, but they do their best to ignore those to whom they are indebted for the hares they cook and dress and eat.

The ability to measure requires industry only, and this description of knowledge can be obtained by simply reading books and attending college courses; the measuring ability is, however, too often obtained at the expense of a mental contraction of the range of thought, and hence our great engineers and epoch-making men have never been, in the true sense of the term, schoolmen.

I now return to Mr. Perry's letter, the latter part of which I quote, because I presume he considers it to be both stinging and crushing. It reads as follows:—

"I had previously been speaking of Sir Wm. Thomson, and I hastily interpolated, after the name *Varley*, the words: 'who was Thomson's partner.' I acknowledge that in this I was very forgetful. Messrs. Cornelius and Samuel A. Varley were the patentees of whom I meant to speak. *But I was even more forgetful than this, for I am quite sure that the readers of the* ELECTRICAL REVIEW *know that the Varleys did not complete their patent in* 1866, *and that it was presumably for this good reason that Hjorth, in his English patent of* 1854, *had described with much greater fullness the principle in question.*"

I assume, from what appears in the above quotation, that Mr. Perry would now wish your readers to believe he was altogether wrong in attributing the discovery of the dynamo principle to anyone of the name of Varley, and he would wish it also to be inferred that my specification was allowed to lapse because Hjorth had more fully disclosed the principle in question in 1854. My reply to what Mr. Perry now says is:—

1. That Mr. Perry must know that protection in the case of my 1866 patent was continued by lodging a second specification before the lapse of the 6 months allowed had expired, and that this second specification was carried through to completion.

2. Mr. Perry well knows that the machine described in the Hjorth's specification of 1854 was *not* a self-exciting dynamo in the accepted sense of the term, and that *it was not the type of every dynamo ever since*, as he truly described mine to have been in his inaugural address.

3. Mr. Perry must also know that the machine described in the 1854 specification of Hjorth was to have been constructed with permanent magnets, assisted by auxilliary electro-magnets.

4. There is every reason for believing that no machine was ever made in accordance with the description given by Hjorth in his 1854 specification. Hjorth was a well-known inventor, whose magneto machines of previous patents had involved capitalists in heavy pecuniary losses, and had such a machine ever been constructed, it would either be in existence now, or some record of it would have existed.

5. Prof. Perry must know that the Hjorth 1854 specification lay buried away in the Patent Office unsuspected up to 1882, 16 years after my 1866 specification had been lodged.

6. Prof. Perry also knows that the Hjorth specification was brought to light through a systematic search of the patent records having been made in 1882 on behalf of Mr. Dredge, in connection with his work on electric illumination, and, further, Mr. Perry probably knows that the woodcut which appears in Dredge's book is not a copy of any machine or drawing; it is simply the mental conception of a dynamo-electrical engineer acquainted with the dynamos of 1882, of the form the machine described in the Hjorth specification would probably have assumed had a machine ever been constructed.

From what has now been stated, your readers will be able to form an opinion as to the value of Mr. Perry's statements.

It is not for me to express any opinion as to what is worthy, or what is not worthy of one who holds the enviable position that Prof. Perry does; but speaking for myself only, I may be allowed to say that I, individually, have the poorest opinion of any one who has so crowded out his moral faculties as to be capable of descending to mere sophistry and casuistry.

I will now explain how it is the name of Cornelius Varley appears in the specification, although he had really nothing whatever to do with the discovery of the dynamo principle. Cornelius Varley was my father, a

man well known in society for his originality and general scientific knowledge. He was an artist by profession, and he and his elder brother, John Varley (the creator of water colour painting), were among the founders of the old Water Colour Society, now the Royal Institute. As a consequence of the death of his eldest son, my father inherited a manufacturing business when he was 80 years of age, and I was induced to throw up my professional position of engineer of the London telegraph district in the service of the Electric and International Company to take the management of the business, and when I say my father, who was never a practical electrician, had entered his 86th year at the time my 1866 dynamo specification was lodged, I think it is scarcely necessary to say he did not discover the dynamo principle. There was, however, a partnership deed between us, and my father's name appeared in all my patents of that period, and as he was my father, I gave his name, not unnaturally, precedence.

I am sorry Prof. Perry has rendered it necessary for me to mention such matters as these, the more so as they were all threshed out in a journalistic controversy in which I became involved with the late Dr. Sir William Siemens in November, 1877. This controversy lasted over two months, and ended in Dr. Siemens having to beat a retreat. In the same November (1877) there was a paper on dynamo-electric machinery down for reading before the Institution of Civil Engineers, but it was adjourned until after the journalistic controversy had been completed. The paper referred to was written by Messrs. Higgs and Brittle, both of whom were in the employ of the Messrs. Siemens at the time. Two editions of this paper were issued from the private press before the paper was read; the first edition was privately circulated at the commencement of the controversy, the second one was issued after its completion, and I have copies of both. Now, in the first edition my claims to the discovery of the dynamo principle were ignored, in the second edition they were recognised, but when the paper was read the aid of Prof. Tyndall was invoked on behalf of Siemens, and he took up the matter *con amore*, employing all his well known powers of eloquence in the discussion which followed the reading of the paper; and subsequently, also at the Royal Institution, to persuade, as far as lay in his power to do, that I had no claims whatever to be considered a discoverer of the dynamo principle; the grounds which he put forward at the Royal Institution for the judgment he had passed was that I had neither read a paper before the Royal Society nor had I published a description of my dynamo in a journal *scientists* recognised.

Whilst on this subject I would state that as I was prevented attending the British Association meeting of 1867 I wrote to Sir William Thomson, the President of the Mathematical Section of that year, telling him of my machine, and asking him to mention it to the Section, as I had been prevented coming down and preparing a paper.

Sir William Thomson, I regret to have to say, did not mention the matter to the meeting, and he did not even acknowledge the receipt of my letter, which I have reason to know, from what afterwards transpired, came to hand as letters usually do. The only comment I have to make in respect to this episode is that had Thomson said a few words to the meeting in reference to my letter I should probably have been spared having to write this letter; further, I consider I had certain moral claims on Thomson at the time I was personally known to Thomson; and I had some little time before entered enthusiastically into certain important work of his, and successfully carried it through, and Thomson considered himself to be under a personal obligation to me at the time this work was done.

I myself look forward with considerable apprehension to our immediate scientific future, and I think the time has already come when our scientific bodies should interpose to prevent science being degraded.

One of the latest outcomes of our physicists is that electric impulses of short duration pass through the outer skin of conductors only, and Sir William Thomson has calculated out the depth to which they enter under given specified conditions. Mr. Preece, referring publicly to this conclusion, has stated "that when so great an authority as Thomson says it is so, who can doubt it?" Now I venture to maintain that scientific notions which are well within the range of direct experiments should not be put forward in inaugural addresses unverified by experiments, but it is much more sensational to appeal to the imagination, and hence the course which is now too often adopted.

I myself believe the conclusion of our physicists above referred to is as big a mare's nest as the one I burst up 30 years ago, and I hope it will be permitted me by direct experiment either to burst it up, or to confirm it, for I am simply a student wishing to arrive at the truth.

The Society of Electrical Engineers is just now considered to be the society of light and leading, and it is in this society that mutual admiration speeches flourish so much. I will give an example of the working of the society within my own experience. In its earlier days Mr. Preece, in a paper contributed by him, condemned my lightning bridges because they had no direct communication with the earth. They had no earth connection because there was a regulation in the Postal Telegraph Department at the time which did not allow of earth wires in intermediate stations. I spoke at some length on that occasion, and proof sheets of my speech, just before the publication of the proceedings, were sent to me for correction. I returned them, and their receipt was acknowledged, but when the proceedings were published I found the whole of my spech had been left out, I presume by the editing committee, of which Prof. Ayrton, I believe, was at that time chairman.

Dr. Sir Lyon Playfair, as Postmaster-General, was made to take credit for the Department having introduced what was described in his report as the greatest improvement which had been effected in the Wheatstone needle telegraph; but my name as the inventor and the introducer was omitted.

In the handbook of the then chief engineer, R. S. Culley, 5th edition, page 199, this invention of mine is described as the greatest improvement in needle telegraphs, but my name is omitted; my lightning bridges are also favourably described in the same book, page 92, my name being omitted.

In my opinion, the true interests of science are suffering from the baneful influence of the Government having a monopoly, which is not a monopoly of telegraphs simply, but of electricity and science generally. The chief electrician is allowed to accept private work; he advises the Crown agents of the Colonies, and is consulted by the Corporations throughout the United Kingdom; and, therefore, he wields practically an almost exclusive patronage in this country and its dependencies.

Since his appointment honours have fallen thick upon him. At the present time he is on the Council of the Royal Society, the Institution of Civil Engineers, the Society of Electrical Engineers, Society of Arts, &c., and he is an attractive lecturer. The lectures of his which have come under my notice are chiefly made up of postal statistics, small jokes, installations of doll's houses, and astonishing fellow travellers by suddenly lighting up incandescent lamps in railway carriages. He had the honour of opening a discussion on lightning conductors at Bath in the presence of Sir W. Thomson and other distinguished professors. I quote from his reported speech: "Professor Lodge was selected to deliver a lecture at the Society of Arts which should crack up and eulogise the report of the Lightning Conductor Conference. But we produced, I am sorry to say, a veritable Balaam, who rode upon the British Ass, &c." At the latter end of the speech from which I have quoted, he expresses himself in the classical language he delights in: "I know he will respond and give me one between the eyes, if he can."

Some few years since a clamour was raised for the Government endowment of science. Since then the technical schools in connection with the City Guilds have been established; and I read in the daily papers that the Central Institute alone has involved the country to the extent of upwards of £300,000.

These schools are presided over by Messrs. Perry and Ayrton and Silvanus Thompson, and they have under their control splendidly equipped scientific establishments. In their advanced pupils they have intelligent and enthusiastic assistants, who can collect information for them, and they have, therefore, every facility for knowing what has been done, and they write the scientific books of the country. I will refer to the treatment I have received at the hands of Silvanus Thompson; in his first and second editions of dynamo-electric machinery he has omitted my name altogether in reference to the discovery of the dynamo principle and construction of the first self-exciting machine; in his third and last edition he makes a short reference to it in the preface only. This reference is misleading altogether, either intentionally or from scientific ignorance, it is one or the other, I do not say which; and as far as I am concerned I do not think it will matter much now, but up to the present time the interested writers of our scientific books have managed to suppress my name in the past to a considerable extent.

There is a confessional in this country where the confessions are printed, viz., the Patent Office. I have spent a few hours there lately, and I find Messrs. Ayrton and Perry have lodged 16 specifications for patents between 1882 and 1888, and that Silvanus Thompson has lodged, in about the same period, 31 applications for patents. I do not think one of the applications describes anything of the nature of a real scientific advance, and that more than one of them might be described by unkind people as what is commonly termed patent grabbing.

By a fiction the endowed scientific Professor now to the fore is supposed to be consumed with an enthusiasm for scientific research and the development of scientific knowledge, but have they not, as a matter of fact, been working hand and glove with the company promoter, and have they not been acting the part of the Witches in "Macbeth" to the public investor, in consideration of professional fees.

We have had sensational lectures on electric railways and telpherage (the greater part of which latter inventions consists in its name); behind these lectures there exists patent rights, and in the further background probably a syndicate waiting to invite the public to subscribe if only they can be worked up into the proper condition of mind.

Now, what I should like to see would be an investigation into the inner working of the technical schools, and into that system which it is not too much to say is rapidly sapping the morality of scientific Professors. I allude to the acceptance by them of general retainers from business corporations.

I annex the descriptions of my exhibit accompanying my original dynamo at the Inventions Exhibition (1885), showing I recognised the claims of Hjorth as far as I considered they deserved.

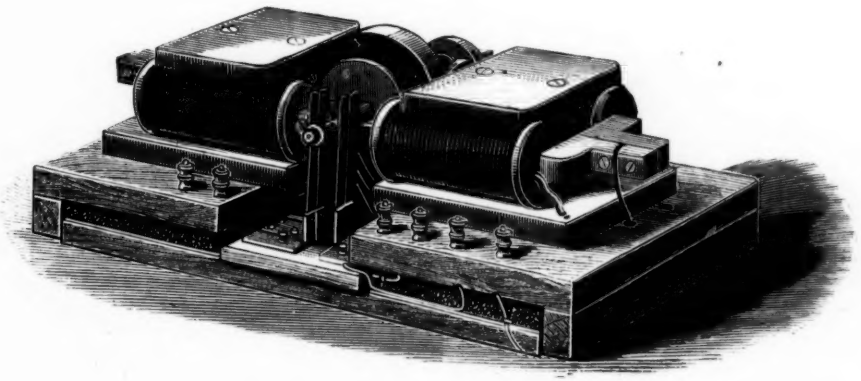
**S. Alfred Varley.**

[It is probable that although many of our readers will agree with much of Mr. Varley's letter, there will be found certain points in which he is certainly in error. If we are not greatly mistaken, the Professors attached to technical schools are not allowed to take retainers, it being a *sine qua non* that on their appointments they should give up commercial pursuits. Nor are we inclined to think that Mr. Varley's lifelong work has been wilfully ignored by those he taxes with want of consideration; but, on the other hand, we think that forgetfulness of his admirable discoveries may be traced, to a great extent, to our correspondent's retiring disposition, he having for many years shunned the society of his fellow electricians. Mr. Varley by nature is neither envious nor vindictive, and we trust that he will some day discover his misfortunes to have been due to other reasons than that of a supposed professional boycotting.—EDS. ELEC. REV.]

ORIGINAL DYNAMO-ELECTRIC MACHINE

(*Constructed by S. Alfred Varley, in August*, 1866, *and provisionally protected in December*, 1866.)

In this machine was introduced, for the first time, what has been described by Sir William Thomson as the fundamental principle of the dynamo.



This new principle (discovered by S. Alfred Varley*), which forms the basis of all the most powerful dynamos of the present day, may be briefly described as the discovery that the small trace of active magnetism usually present in the ordinary iron of commerce can be used as a fulcrum for mechanical force to act upon, and to develop electricity, not only in the way discovered by Faraday, but in such a way as to exalt the magnetism in the iron of the dynamo itself; so that as long as mechanical force is being consumed in imparting motion to the machine, the iron which, when the machine is at rest, may be regarded as magnetically passive, becomes magnetised to the highest degree, and produces electricity in quantities corresponding to the magnetic exaltation, and the amount of mechanical force absorbed in producing it.

Extract from article on Electrical Apparatus, in Handbook to the Special Loan Collection of Scientific Apparatus at South Kensington, in 1876, by Prof. Carey Foster, F.R.S., &c. :—

"In the same year (viz., 1866), S. A. Varley, and in the following year Siemens and Wheatstone, almost simultaneously constructed machines in which permanent magnets were entirely dispensed with."

*Note 1.—This same principle, a little later on, was also independently discovered by Sir Charles Wheatstone and Dr. Werner Siemens, both of whom communicated their discoveries in papers read before the Royal Society, on February 14th, 1867.

Extract from treatise on "Electric Transmission of Power," by Paget Higgs, LL.D., published in 1879 :—

"The step from magneto-electric to dynamo-electric machines was due to S. Alfred Varley, Sir Charles Wheatstone, and Dr. Werner Siemens, who quite independently discovered and worked upon the same principle of accumulation by mutual action, the priority falling to Mr. Varley by his patent."

Extract from Sir William Thomson's Address on the Scientific Progress of the last Fifty Years, at the Meeting of the British Association at York, in 1881 :—

"This (viz., the production of the electric light by permanent magnets, and its application to the South Foreland light, by Prof. Holmes, in December, 1858), gave the impulse to invention by which the electro-magnetic machine has been brought from the physical laboratory into the province of engineering, *and has sent back to the realm of pure science a beautiful discovery—that of the fundamental principle of the dynamo, made triply and independently, and as nearly as may be, simultaneously, by* Dr. Werner Siemens, Mr. S. A. Varley, *and* Sir Charles Wheatstone."

*Note* 2.—A search made at the Patent Office in 1882 revealed the fact (previously unknown) that Soren Hjorth, of Copenhagen, had, in 1854, provisionally protected an invention in which permanent magnets, combined with electro-magnets, were to be used for producing electricity, and in which the electro-magnets were to be excited by electricity produced in the machine. This invention does not appear to have been tested, and the drawings which accompany the specification do not clearly show the construction; but if a machine, acting as described in Hjorth's specifiation, had been actually made, it would have been an approach to the dynamo principle, and machines of tke pure dynamo type would, in all probability, have been produced at an earlier date than 1866.—S.A.V.

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### Electrical Trades Union.

I have taken the opportunity to reply to your correspondent concerning the lately formed Electrical Trades Union. You are aware that there have been two public meetings held, of which due notice was given in your valuable paper and the *Star*; no one was excluded from those meetings, it made no difference to us who attended, but, at the same time, experience teaches us that the men who take a prominent part in newly formed trade unions are, in a great many instances, what you may term marked men. Such being the case it behoves us to be cautious, but, at the same time, I being the chairman who presided at the opening meeting, am not afraid to have my name made public. I gave those who attended to understand that it was no agitation got up against employers but quite to the contrary, and that the men employed by the National Telephone Company in London had no grievances; so long as they treated us in the future as they had in the past we had no complaints against them. What we intend to do is to form this society on trade union principles to help each other when out of employment and likewise to assist each other in finding employment, and employers will likewise benefit when they require men. It will act as a Labour Bureau; they will be able to rely upon the men being up to their work and not taking positions they cannot fulfil, and I, for one, see no reason why we should hold our names aloof, as there is not a shadow of doubt employers would have very little trouble in finding out who are at the head of this movement. The rules of this union will be approved of at a general meeting of all members enrolled. I can assure you we are a great many considering the short time since our first meeting was held. The society will be registered under the Friendly Society Act, and if there is any rule detrimental to the employers the Registrar General will no doubt see to that. I think this is quite sufficient proof to your correspondent that we are not what are termed professional agitators. I have been employed at the United Telephone Company six years, which will vouch for my character. As regards the officials of this society I have been elected treasurer *(pro tem)*, and likewise one of the delegates to represent the London men at the conference about to be held in Manchester, as we intend this society to cover the whole of the United Kingdom, the same as the engineers' or carpenters and joiners' unions. I would thank you to kindly publish this letter in answer to Mr. Wallace Jh. Sandy, and should very much like him, whoever he may be, to forward his address and I will give him any information that lies in my power concerning the union.

**W. T. Gooday.**

*November 10th*, 1889.

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In reply to your correspondent Mr. Sandy, I will ask that gentleman what end we are likely to gain by making our names public. He reminds me of Captain Macheath singing—

> How happy could I be with either, were t'other dear charmer away;
> But since you thus tease me together, to neither a word will I say.

We shall be delighted to receive him amongst us and then he will know all he expresses ignorance of at the present moment. From the style of his letter I venture to think he will be of great assistance to us, and we shall be pleased to receive his name and entrance fee as early as possible. The latter is 2s. 6d.

**The Chairman of the Meeting, October 26th, 1889.**

*November 9th*, 1889.

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### Energy and Electricity.

Mr. Desmond FitzGerald has, I see, taken note of my remarks of a fortnight ago. It is always interesting, and often amusing, to get a third party to a controversy, who holds different views from either of the other two. In the present case it is doubly so, from the fact that it is worthy of note how many absurdities can be pressed into one short little letter. Why will Mr. FitzGerald (among others) write nonsense; for nonsense it most assuredly is, to waste editor's paper and readers' time in telling you such things as that electricity is not a vegetable product, &c. People judge of others' knowledge by their own, and therefore Mr. FitzGerald may, perhaps, on these grounds, be excused; but it is really hardly fair to others to say that "*we* can predicate with certainty that electricity is not a 'Mode of Energy.'" Of course he can predicate what he pleases, but he might give others a chance of doing the same.

A good many—and among others, myself—support the view that *electricity is a form of energy*. The lightning flash is not electricity, although perhaps Mr. Mr. FitzGerald might be "cocksure" that it was so. The light, and heat thereof, are products, results, or effects of electricity; but the electricity itself is neither factor, nor product of anything or things, but simply that form which the energy has, from some cause or other, taken in the cloud, air, or earth, and which affects the condition of the said earth, air, and cloud. I should like to have asked Mr. FitzGerald what the other factor is which gives energy as the product; or even, energy being one factor, what the other factor of electricity would be; but I'm afraid an answer to these questions would be too much to expect.

I think that most people will agree with me that electricity is not matter. If it effects work (as who will gainsay it), then assuredly it is a force; I am sure that there are but few who would, in the existing state of our knowledge, deny that force and energy are one and the same thing. Electricity being force, and force being energy, electricity must be energy. Q.E.D.

Thanking you in advance for the insertion of the above, and trusting I have not taken up too much of your valuable space.

**Leonard Joseph.**